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THE PHILOSOPHY OF FLOWER SEASONS, AND THE PHAENOLOGICAL RELATIONS OF THE ENTOMOPHILOUS FLORA AND THE ANTHOPHILOUS INSECT FAUNA.

By CHARLES ROBERTSON.

The writer's determination to discuss the subject of flower seasons at the present time is owing to the publication, by Mr. Henry L. Clarke, of an interesting and suggestive paper on the same topic in the NATURALIST for September, 1893. Having been engaged since 1886 in the investigation of the mutual relations of flowers and insects, he has been led in a very natural way to consider the time of blooming of flowers adapted to insects and the time of flight of the insects which depend more or less upon a floral diet. In 1890 a tabulation of both groups was begun, based upon the data then at hand, and since that time the author has had lying before him lines indicating the periods of the separate species and curves indicating the periods of the families of entomophilous plants and of the genera of bees, and the families of the principal remaining anthophilous insects; all, however, in the process of being modified by the accumulation of data. As a result, certain views have been arrived at regarding the relations of the

periods of particular flowers to particular species of insects, of families of plants to certain groups of insects, and the relative positions of different groups. Under these circumstances, Mr. Clarke's paper was read with particular interest, though it has not seemed to justify an abandonment of theoretical conclusions previously held.

The factors admitted by Mr. Clarke to have an influence in determining the blooming time of flowers are as follows:

1. "The blooming period may sometimes vary from the general rule to better bring the flowers among the most favorable conditions for cross-fertilization."

2. "Again, plants that are frontiersmen from the characteristic vegetation of a hotter clime may be expected in the hottest of the seasons—*e. g.*, the Cactaceae."

3. "There is an evident limitation of the flowering of our trees and shrubs to spring and earliest summer." "The blossoming of so many trees, especially the Diclinae, in earliest spring, before leaf-budding, must evidently have at least partial connection with anemophilous cross-fertilization."

4. "Again, there is a determining function in the character of the flower's habitat—the spring flowers seek largely the protection of the woodlands; marsh plants reach perfection mainly in latest spring and through the summer, though some, like Caltha, are early; the aquatics of ponds and river glory in the summer sun; and the flowers of meadow and prairie and thicket margin luxuriate from midsummer to the end of autumn."

But the principal deductions of Mr. Clarke are these: "*From early spring to late autumn there is a progression in the general character of the flower groups, from the lower to the higher—successive groups succeeding each other in time, parallel groups coming synchronously.* And the later in order may be *types* of a higher character of development, or they may be *specializations* of a group whose *normal* forms belonged to an earlier season. In their blooming season, *the more perfect succeed the more simple; the aberrant, the normal; the specialized, the g ralized.*"

In the solution of the problem of the flower seasons of a given flora I think that the period of no plant should enter as a factor, if it is so far removed geographically that at its blooming time it does not become a competitor of any plant of that flora. Any number of flowers adapted to the same conditions may bloom at the same time if they are so widely separated that they do not interfere with one another, but it would be an obvious disadvantage for very many of them to bloom at the same time in the same locality. In the latter case a separation of the blooming times would be advantageous. On the other hand, there are some objections to the use of data derived from a local flora, though I think they are not so serious. Phenomena which seem to find an explanation in a limited field may in fact find their true explanation in conditions outside of that field. Even in the case of a local flora the time of blooming is likely to be indicated as too long, since it is based upon the early dates of early seasons, and the late dates of late ones. Such data give rise to error by making it appear that the period of an early species overlaps with that of a later one when in fact the two species never have flowers in bloom at the same time in any season. It is hardly practicable to avoid this, since observations confined to a single season are liable to be too fragmentary.

To note that a given family of plants is highly specialized and that it agrees with Mr. Clarke's generalization by reaching its maximum in summer, does not help one to understand either the general position of the family or the blooming time of a single species, and the difficulty remains the same whether the species blooms before or after the bulk of the family, or whether its season coincides with the maximum. The main fault that may be found with his elucidation of the subject is that it is implied that the general principle of the late blooming of highly specialized flowers is an explanation of the blooming phenomena; for, whenever a flower agrees with the generalization, it is left as if it were thus explained, while, if it is an exception, its period is accounted for under the considerations which we have numbered. And it must have been a striking fact to the readers of the paper that the exceptions yielded so

readily to these considerations that they remained the only cases which were clearly elucidated. But it is hardly fair to dwell too strongly upon this point, for towards the close of the article, Mr. Clarke has expressly said: "Here the question rises, why should there be a correspondence between the course of the flower seasons and the system of floral evolution? Solve this and the 'Philosophy of flower seasons' is an open riddle." Stated in this way, as a very interesting and important fact to be explained, I see little in the paper to which objection can be made. Otherwise, it might not unfairly be considered as an attempted refutation of the Darwinian flower theory, for what becomes of that theory if it can be shown that the time of blooming of insect-pollinated flowers is not correlated with the time of flight of flower-loving insects?

The object of this paper will be to attempt a preliminary contribution to the subject from the standpoint of data derived from the *indigenous* local flora near Carlinville, Illinois (lat. 39° 21′), to test Mr. Clarke's main proposition, to undertake to account for flower seasons as a result of the competition of plants for the services of various pollinating agencies, and those of insect-loving flowers as also correlated with the flight of flower-loving insects, and to attempt an explanation of the fact of the general preponderance of the most highly specialized flowers in late summer.

When a plant in a plastic condition succeeds in establishing itself in a highly favorable position, it throws off a number of closely allied forms which finally become more or less well marked incipient species. As a result we find a number of nearly related forms in competition for a similar position in the soil, for a favorable position in the sunlight, and for the aid of the same pollinating agency. The process of producing similar forms may go on until the competition becomes so severe that it becomes disadvantageous. Then it becomes advantageous for some of the forms to avoid competition[1] with the dominant group by migrating to a different region, or to a different kind

[1] In the interaction of organisms in the struggle for existence it strikes me that a law of avoidance of competition is more obvious than that of the survival of the fittest.

of soil, to modify their floral characters so as to attract a different set of visitors, or to separate their times of blooming so that they may not have to compete with a great many similar flowers for the attention of the same kinds of insects. As a consequence we find the forms separating their blooming times so as to come, some before, and some after, the maximum of the group, though the maximum of the whole will probably coincide with the position of the maximum of the dominant forms. The maximum point, then as a rule, at least, marks the point of origin of the group, but the struggle for existence requires a departure from it. Instead, therefore, of indicating a point of convergence for the group, the maximum point is the place of divergence, so that there is no law [2] according to which the forms tend to concentrate at this point. If one of the forms which has departed from the maximum point comes to fill a much more favorable position, it may finally give rise to so numerous a progeny of forms that the maximum of the group will change position and no longer coincide with the point of origin.

In looking over my tabulations with these considerations in mind I note that, as a rule, incipient and closely allied species bloom synchronously, while more distinct species, and species of different genera are more likely to be widely separated. In large genera containing numerous closely allied species, which indicates a more recent origin, most of the species bloom together, and it is a notable fact that such genera have a potent influence in determining the maximum point of the groups to which they belong. Thus the species of buttercups (*Ranunculus*),violets (*Viola*), St. John's wort (*Hypericum*), tick-trefoil (*Desmodium*), golden-rods (*Solidago*), boneset (*Eupatorium*), sunflower (*Helianthus*), aster, milkweed (*Asclepias*), verbena, and smartweed (*Polygonum*), with rare exceptions, bloom simultaneously. The maximum of the buttercup family (Ranunculaceae) coincides with that of *Ranunculus*, that of Leguminosae with the position of *Desmodium*, while the maximum

[2] In the migration of some highly specialized groups which MacMillan calls "north bound," I think there has been a retardation of the blooming seasons which has tended to concentrate the species and thus form late maxima.

of Compositae is determined by the position of the asters, *Eupatorium*, golden-rods and sunflowers.

As a result of the divergence of the blooming periods from the maximum point of the group we find that plants come into competition with species of other groups, but as a rule they can stand this better than competition with their own allies.

Trees have such a remarkable influence upon one another and upon the herbaceous flora that they should properly, it seems, be considered separately. The fact that most of them agree in being wind-pollinated is an additional reason for this course. Of 488 indigenous insect-pollinated plants, upon which my observations are based, only 18 are trees. On examining the curve for the insect-loving flora (Fig 1, Plate VIII, 5 species to the millimetre),[3] it will be observed that the maximum is reached in August. At this time 187 species are in bloom, but not a single tree is among them. The flowers of trees are so interfered with by their own leaves and the leaves of other trees that it is disadvantageous for them to bloom after the leaves are fully developed. In the case of wind-pollinated trees it is obvious that, if the leaves were developed before the flowers, the process of pollination would be greatly impeded by the leaves interfering with the free circulation of the wind and catching the pollen which is intended for the stigmas. This fact makes trees an evident exception to Mr. Clarke's generalization, though they are frequently less specialized than their later flowering allies. In the anemophilous nettle family (Urticaceae) there is a marked contrast between the blooming times of the trees and herbaceous species, as stated by Mr. Clarke. Thus the elm, hackberry and mulberry are early, while the hop, hemp and wood-nettle (*Laportea*) are late.

In the case of insect-pollinated trees the conditions are similar to those of wind-pollinated ones, and they generally

[3] Unless otherwise specified, the curves given in this paper are on the scale of one species to the millimetre, *i, e.*, the height of the curve in millimetres indicates the number of insects flying, or flowers in bloom at a given time. The details on which the curves are based will be given elsewhere.

bloom before the leaves are developed, the witch-hazel notably after the leaves have fallen. The leaves act in an equally disadvantageous way, by concealing the flowers so that insects do not easily find them. Before the leaves have appeared in the woods, the trees which depend upon insects for pollination are very conspicuous and have a good chance of being attended by the insects which are attracted by their own flowers and by the flowers of the herbaceous plants which grow under their protection. Later, when the woods become shady, there are few herbaceous flowers, and few insects to attend the trees if they should bear flowers dependent upon them. The rose family (Rosaceae) is of particular interest, since of the larger families it contains the greatest number of trees., and as its maximum is early (Fig. 14, Plate VIII), it is the only one of the entomophilous tree-producing families, which is in a favorable position for giving rise to aborescent forms. The first to bloom is the service-berry (*Amelanchier*), and the trees, *e. g.*, the plum, cherry, apple and hawthorn, coincide pretty nearly with the maximum of the family, though it is significant that the latest species are herbaceous. As the season advances, the flowering of trees and of herbaceous plants which grow under them is evidently cut short in correlation with the appearance of the overshadowing leaves.[4]

While it is not my intention to discuss wind-pollinated plants specially at this time, I think that their blooming seasons may be explained by reference to their competition among themselves and with the insect-pollinated flora. Even in herbaceous plants it seems that the spring might reasonably be expected to be the most favorable for pollination, since they would be less likely to be overtopped by the later plants which become increasingly more luxuriant. But at different seasons they can readily occupy positions unfavorable to entomophilous plants, and in summer they may endure the competition of the entomophilous flora better than that of an indefinite number of plants depending upon the wind, or better

[4] One of my favorite botanizing grounds shows a great variety of vernal flowers, but after the appearance of the leaves is covered by a uniform growth of the anemophilous wood-nettle (*Laportea canadensis*).

than to resort to insect-pollination. In the cases of anemophilous Ranunculaceae, such as meadow-rue (*Thalictrum*), and Compositae, such as rag-weed (*Ambrosia*), it is probable that wind-pollination has been resorted to by way of avoiding competition with their allies, and it is notable that these plants bloom near the maximum points of the families to which they belong.

A comparison of the insect-pollinated Monocotyledons (Fig. 7, Plate VIII) with the general entomophilous flora (Fig. 1, Plate VIII) yields a more striking contrast than would result from a comparison of the two groups in general, for the former loses the large wind-loving families of sedges and grasses, the latter blooming late, and the general flora loses the early blooming wind-loving trees. In this group we observe that the terrestrial species, without regard to specialization, bloom early, while the aquatic ones are late. This I think is largely a result of the severe competition of the former with the highly specialized terrestrial flora, a competition from which the aquatics have been largely relieved by their position.

As regards those of the Liliiflorae having the carpels separate (apocarpal) and those having them united (syncarpal) I am unable to agree that the former are more highly specialized, and so must consider that their blooming time is opposed to the proposition that the more highly specialized flowers bloom later.

The curve for the Choripetalae (Polypetalae and Apetalae, Fig. 2, Plate VIII.—5 spp. per mm.) shows a maximum in August of 73 species, and a secondary maximum in April of 71 species, and the curve diminishes from both to about the middle of June, when there are 49 species in bloom. Of the Hypogynae (Fig. 3, Plate VIII.—2 spp. per mm.) 43 species bloom simultaneously in May, after which they pretty regularly decline. With the addition of the hypogynous Apetalae, the maximum remains the same, but there is a secondary elevation in August. The Perigynae (Fig. 5, Plate VIII. —2 spp. per mm.) show an August maximum on account of the strong preponderance of the Leguminosae. Among the

Epigynae (Fig. 4, Plate VIII) the ginsengs (Araliaceae), dogwoods (Cornaceae), wild ginger and pipe-vine (Aristolochiaceae), as Mr. Clarke observes, come early. In regard to the Umbelliferae (Fig. 18, Plate VIII), however, my observations do not show them " in fullest sovereignty in July and August," for at that time only four species bloom together, while there are 11 species in flower in May. Contrary to Mr.Clarke's theory, the more highly specialized Epigynae (Fig. 4, Plate VIII) show a stronger tendency than the Perigynae (Fig. 5, Plate VIII to form an early maximum.

Even the less specialized of the two dominant families of Perigynae (the Rosaceae, 14) does not equal the Umbelliferae in the formation of an early maximum, *i. e.*, it does not decline so rapidly from the early elevation. I think that the Umbelliferae are more highly specialized than the Myrtales (Lythraceae and Onagraceae) and so reverse the order of Mr. Clarke's theory. But the maximum of the Myrtales (17) anticipates that of the Leguminosae (15).

Of the hypogynous Sympetalae (Gamopetalae), the phloxes (Polemoniaceae), water-leaf family (Hydrophyllaceae) and borage family (Borraginaceae) are early; of 12 species all but one begin to bloom before June, and only two are in bloom after July 1st (Fig. 20, Plate VIII). The more numerous mint family (Labiatae, Fig. 13, Plate VIII) and Scropulariaceae (Fig. 19, Plate VIII) predominate in the summer. Observations on the Epigynae indicate that the flowers of the honeysuckle and madder families (Caprifoliaceae and Rubiaceae) are most abundant in the last of May and first of June. The lobelias and campanulas are most abundant in August. Of all the dominant families, the, Compositae (Fig. 21, Plate IX.—2 spp. per mm.) show the latest maximum. The tendency of the more highly specialized Sympetalae to form a strong late maximum is more marked than in the case of the more simple Choripetalae.

In order to illustrate to what extent the time of blooming of plants is correlated with the time of flight of insects, curves are reproduced showing the periods of the principal flower-loving insects, *e. g.*, the bees (Fig, 24, Plate IX), the other

Aculeate Hymenoptera (Fig. 25, Plate IX), the butterflies (Fig. 23, Plate IX), and the flies (Fig. 22, Plate IX)—all on the scale of five species to the millimetre. No curve is made out for the whole because these curves agree in showing a maximum for July, which, of course, would determine the position of the general maximum.[5] The bees are by far the most important, since they depend upon flowers both for their own food and for that of their young. As a rule, except in the case of the cuckoo bees, which lay their eggs upon food deposited by the host bees, the female bees are provided with brushes of hair upon which they carry pollen, the essential part of the bee-bread, upon which the larvæ feed.

In a previous examination of the curve for the Choripetalae (Fig. 2, Plate VIII) there was observed a maximum in August, a secondary elevation in May, and an intervening depression in June.

With the principal exception of the Leguminosae (Fig. 15, plate VIII), these plants have horizontally expanded regular flowers, with readily accessible nectar and stamens exposed so that the pollen is easily collected or eaten. The Leguminosae generally have lateral irregular flowers, with the nectar concealed and deep-seated, and intricately concealed pollen, for which reason they will be separated for special consideration. Now, since the maximum for the Choripetalae coincides with that of the Leguminosae, the separation of this family will change the maximum of the group to the secondary point. There are two families of insects which are particularly fond of simple flowers with easily accessible nectar and pollen—the less specialized bees (Andrenidae, Fig. 26, Plate IX.—2 spp. per mm.) and the flower-flies (Syrphidae, Fig. 36, Plate X.—2 spp. per mm.)—and they both have more species flying in early spring. There is no question but that the strong predominance of the more simple Choripetalae is, to a great extent, correlated with the early predominance of the Andrenidae and Syrphidae. The flowers of the buttercup family (Ranunculaceae, Fig. 9, Plate VIII) and of the Rosaceae (Fig.

[5] My phaenological observations are most defective for August. I expect to find the maximum of the general anthophilous insect fauna a little later.

14, Plate VIII) with their numerous stamens are the particular favorites of the less specialized bees, and it would be fairly impossible for them to be so efficiently attended late in the season. No flowers are more convenient for the imperfectly adapted flower insects than those of the parsley family (Umbelliferae, Fig. 18, Plate VIII). While the later blooming species are visited by a more numerous set of insects, the visitors are less efficient. The flowers are somewhat neglected by the higher bees (Apidae, Fig. 27, Plate IX.—2 spp. per mm.). so that in order to secure the most useful set of visitors it is desirable to bloom early, under the maximum of the Andrenidae. I have shown that the harbinger of spring (Erigenia), the earliest spring flower, has a larger percentage of bees among its visitors than any other plant of the family, and that the early blooming species with simply concealed nectar show more bees as visitors than those with deep-seated nectar but blooming late. On consulting the curves for bees (24) and other Aculeate Hymenoptera (25) and flies (22), it will be observed that early in the season the predominant insects are bees and flies, so that by early blooming the less specialized flowers gain an advantage similar to that secured by the more highly specialized in a later season in concealing their nectar, *i. e.*, they acquire a higher proportion of the more efficient flower insects. The pond lilies (Nymphaeaceae) come in bloom late, probably on account of their aquatic habitat and have a long period, probably on account of occupying a position free from the competition of overshadowing form, but they are pollinated by late-flying bees and flower flies; and I have named two species of bees (*Halictus nelumbonis* and *Prosopis nelumbonis*) on account of their close economic relation to these flowers. The violets (Fig. 16, Plate VIII) are spring flowers, there being no normal late-blooming indigenous species. Those with the lateral petals bearded are adapted to the mason bees (Osmia, Fig. 31, Plate IX), small greenish species with pollen-collecting brushes on the ventral surface of the abdomen, which fly early apparently to avoid competition with the large allied genus of leaf-cutter bees (Megachile, Fig. 32, Plate IX). When visiting the violets these

bees turn head downwards and hang upon the beards of the lateral petals while they collect the falling pollen. The violets also have an important pollinator in *Andrena violæ* of the spring group of *Andrena* (Fig. 35, Plate X). The swamp rose-mallow (*Hibiscus lasiocarpus*, Fig. 6a, Plate VIII) has a blooming time correlated with the time of flight of a characteristic American bee (*Emphor bombiformis*, Fig. 6b, Plate VIII), its principal pollinator; the bee in turn depending on the *Hibiscus* for its pollen. Another interesting case of correlation in appearance and mutual dependence is, that of an alum-root (*Heuchera hispida* Fig. 11a, Plate VIII) and a little bee (*Colletes aestivalis*, Fig. 11b, Plate VIII).

Returning to the Leguminosae (Fig. 15, Plate VIII) we observe that of the species which form the August maximum all are adapted to the most intelligent of the highest specialized genera of bees. Quite a number are bumble-bee flowers. The ordinary flowers have the stamens declined to the lower side and are best fitted to be pollinated by the leaf-cutter bees (Fig. 32, Plate IX), which have abdominal brushes for collecting pollen, and I think that the position of the family in general should be regarded as associated with the flight of these bees. Two species adapted to bumble-bees, a ground plum (*Astragalus mexicanus*) and a false indigo (*Baptisia leucophaea*), occur early, which they may do without going out of the range of bumble-bees (Fig. 30, Plate IX) and they each gain an advantage by avoiding competition with a late blooming congener also depending upon bumble-bees. But no other ordinary papilionaceous flower blooms out of the flying time of the leaf-cutter bees. The very earliest of the family, the red-bud (*Cercis canadensis*) has the stamens declined to the lower side of the flower, so that the pollen is easily gathered by the mason bees (Fig. 31, Plate IX), which we have already mentioned as having abdominal brushes, like the leaf-cutters (Fig. 32, Plate IX), but fly early. The early appearance of the red-bud seems to be influenced by the early flight of these bees, though it is not exclusively visited by them. Finally, therefore, with regard to the blooming phenomena of the Choripetalae, we close with the propositions that the early preponderance of the

more simple open flowers is determined by the early predominance of the less specialized bees, and that the late preponderance of the more complicated closed flowers is correlated with the flight of the most specialized bees, leaf-cutters, bumblebees, etc.[6]

The Sympetalae (Gamopetalae) consist of flowers with more or less deepseated nectar and often with closed complicated flowers. They are adapted to bumble-bees or to the more highly specialized bees in general, to butterflies or to miscellaneous more or less long-tongued insects. An interesting case is that of flowers of *Steironema* which are associated with the flight of *Macropis steironematis*, a bee which as far as observed depends exclusively upon these flowers for its pollen. The wild potato vine (*Ipomoea pandurata*) is dependent mainly upon two bees (*Entechnia taurea* and *Xenoglossa ipomoeae*). The flowers of ground cherry (*Physalis*) bloom during the flight of two species of *Colletes* (*C. willistonii* and *C. latitarsis*), upon which they depend almost exclusively for pollination, the little bees on the other hand, obtaining all of their pollen from these flowers. The dominant mint family (Labiatae, Fig. 13, Plate VIII) is principally adapted to the higher bees, although some having degraded irregular flowers with exposed stamens are adapted to miscellaneous insects. The figwort family (Scrophulariaceae, Fig. 19, Plate VIII) is an even more exclusive bee-flower family, most of them being adapted to bumble-bees, and appearing late. The earliest species, *Collinsia verna*, is one of the most highly specialized and looks like a papilionaceous flower. The upper lip and the lateral lobes of the lower lip represent banner and wings, while the middle lobe represents the keel, and it performs the same function for it contains the stamens, which instead of lying against the upper wall of the corolla, as is usual in the family, are declined across the tube. We have observed that most of the Leguminosae with declined stamens are adapted to bees with abdominal

[6] The early blooming of the dominant families of Choripetalae, as well as the Liliiflorae, must also be explained in part as correlated with their woodland habitat, their decline being influenced by the appearance of the leaves on the trees.

pollen brushes (*Megachile*, Fig. 32, Plate IX), and now in the case of this flower we find the principal visitors to be bees of the genus *Osmia* (Fig. 31, Plate IX); so that it joins the red-bud and violet in appearing during the flight of these bees. The figwort (*Scrophularia*) and *Symphoricarpus* come late in adjustment to the flight of the wasp workers and Eumenidae to which they are specially adapted. The late position of the lobelias is what might be expected, since they are dependent upon the visits of the higher bees (Fig. 27, Plate IX). We come finally to consider the great highly specialized family of sunflowers, nigger-heads, thistles, etc., (Compositae, Fig. 21,–2 spp. per mm. Plate IX) which shows a conspicuous late maximum and is the best example of Mr. Clarke's theory, though I think one of the easiest to explain without it.

The composite heads, which give the name to the family, are composed of florets arranged generally in a flat-topped horizontal layer which forms a convenient resting place for all kinds of insects. There is abundant nectar for the longer tongues and abundant pollen exposed for the least specialized to feed upon or to collect. From these peculiarities and from their great numbers we find this family to be of more importance to the general insect fauna than any other. The most important visitors are the higher bees, especially bumble-bees (Fig. 30, Plate IX), the leaf-cutters (Fig. 32, Plate IX) and *Melissodes* (Fig. 29, Plate IX), and lower Aculeate Hymenoptera in general (Fig. 25, Plate IX), the butterflies (Fig. 23, Plate IX), the flies, including many flower-flies (Fig. 36, Plate X), the tachinids (Fig. 37, Plate I), the conopids (Fig. 38, Plate X), and the bombylids (Fig. 39, Plate X). The occurrence of the maximum of the family after that of the general flower-loving insect fauna, I think, is largely due to the abundance of the goldenrods, asters, etc., which have rather small heads and less-deeply concealed nectar. The position of these flowers is accounted for in correlation with the position of the usually smaller insects by which they are attended, viz.; the little bees belonging to the genera *Calliopsis* (Fig. 34, Plate IX), the late *Colletes* (Fig. 33, Plate IX), the autumnal group of *Andrena* (Fig. 35, Plate X) and the Bombylidae (Fig. 39, Plate X)—all important guests

and all having late maxima. These late Compositae have few competitors outside of their family and so are favorably situated, although the insect fauna has begun to decline. We will now leave the Sympetalae with the general statement that the late preponderance of the irregular flowers is explained in connection with the late preponderance of the higher bees, and that of the regular flowers is accounted for in the late maxima of the highly specialized long-tongued insects.

We have reviewed the principal groups of insect-pollinated plants and have noted a correspondence, more or less well marked, between their blooming seasons and the seasons of the insects upon which they depend. In different positions we find bumble-bee flowers and, although they all occur within the time of flight of these insects, it is not easy to explain why one of these flowers comes at one time and another at another time. Under the maximum of the buttercup family (Fig. 9, Plate VIII) we find a bumble-bee flower in the larkspur (*Delphinium tricorne*) and under the maximum of Leguminosae (Fig. 15, Plate VIII) another in a tick-trefoil (*Desmodium canadense*). We may say that the larkspur comes earlier because it had its origin in an earlier group. The flight of the bumble-bees, however, cannot be left out of consideration. It is obvious that a bumble-bee flower cannot arise at a time when the attentions of bumble-bees cannot be secured, so that the flight of the bees determines the time within which these flowers may have their origin. When a flower undergoing modification to suit bumble-bees changes its characters so that it no longer comes in competition with its allies, it becomes a competitor of other bumble-bee flowers. A point at which many of these are in bloom simultaneously would naturally be an unfavorable time, unless the new form should early offer more inviting attractions. If the blooming time were long, the attentions of the bees would be likely to be most constant at the point where there were the fewest competitors, and so finally the blooming time would tend to be limited to this point. Or if the earlier flowers were better tended, so that they became the most effectually fertilized, the blooming time would tend to become earlier. Some flowers we find far from the "tension" points

of their groups, having no doubt shifted to take a more favorable position under the competition of other flowers. Thus the earliest member of the mint family (Fig. 13, Plate VIII), is a bumble-bee flower, and some of the earliest of the figwort family (Fig. 19, Plate VIII) are adapted to these insects. The larkspur itself is anticipated by four bumble-bee flowers belonging to more highly specialized families. We would, therefore, expect to find bumble-bee flowers at favorable points of origin or shifted to favorable positions, and the whole group of flowers so disposed as to share the services of these long-tongues with as little interference among themselves as possible. Of the sixty-four species on which the curve (Fig. 41, Plate X) is based the different forms succeed one another from the first of April until the middle of October in such a way that not more than twenty-five species are in bloom at the same time. Twenty-six have completed their flowering by the last of June. We will compare this curve with that for bumble-bees. The first bumble-bees which fly in the spring are the females; in May, June and July the workers appear; and finally in July, the males. The workers are more abundant and even more industrious than the females, and the males are frequently quite numerous and efficient flower visitors. In making a curve for bumble-bees (Fig. 30, Plate IX), therefore, I have introduced each sex as an element so that the maximum coincides with the flight of the three forms, and I think this is the only way to indicate in a curve the function of the genus as a pollinating agency. Now if we compare the curve for bumble-bees (Fig. 30, Plate IX) with the curve for the bumble-bee flowers (Fig. 41, Plate X) we find a well marked coincidence.

The curve for the other flowers adapted to the higher bees (Fig. 44, Plate X) indicates a more pronounced maximum, evidently because the higher bees in general show a more marked preponderance in summer. Of sixty-nine species on which the curve is based, thirty are in bloom simultaneously at the maximum point.

Now as observed above, the lower bees (Andrenidae, Fig. 26 Plate IX) prefer erect simple flowers with easily accessible nectar

PLATE VIII.

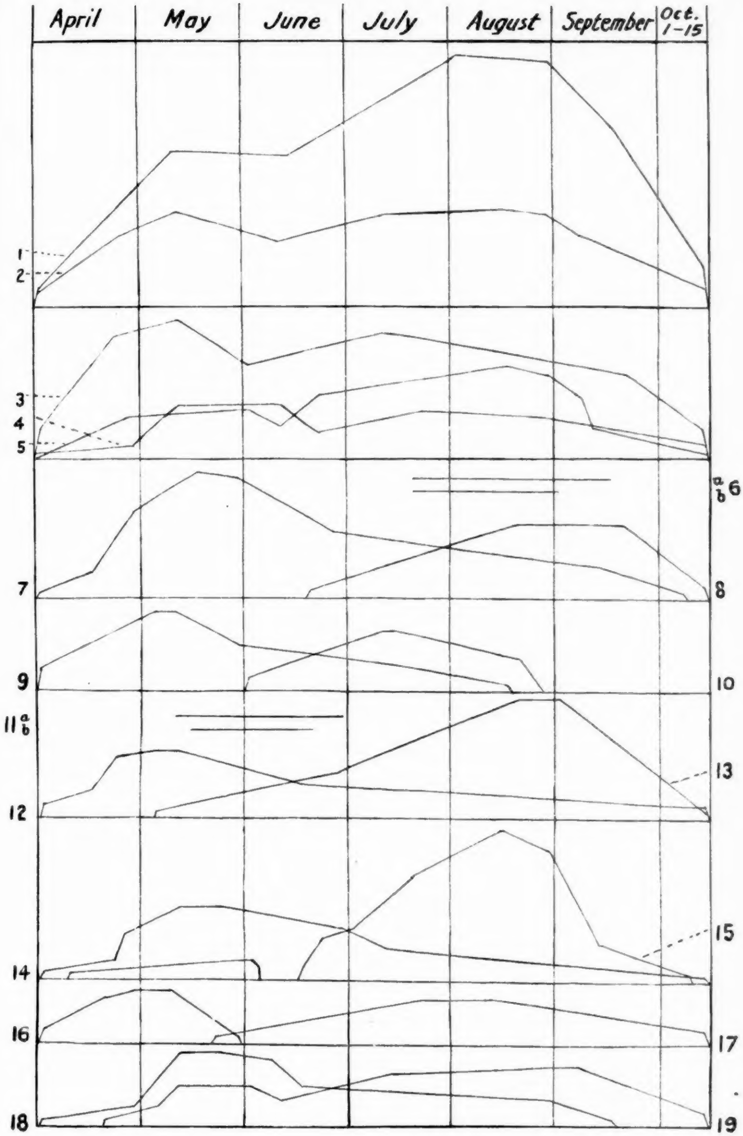
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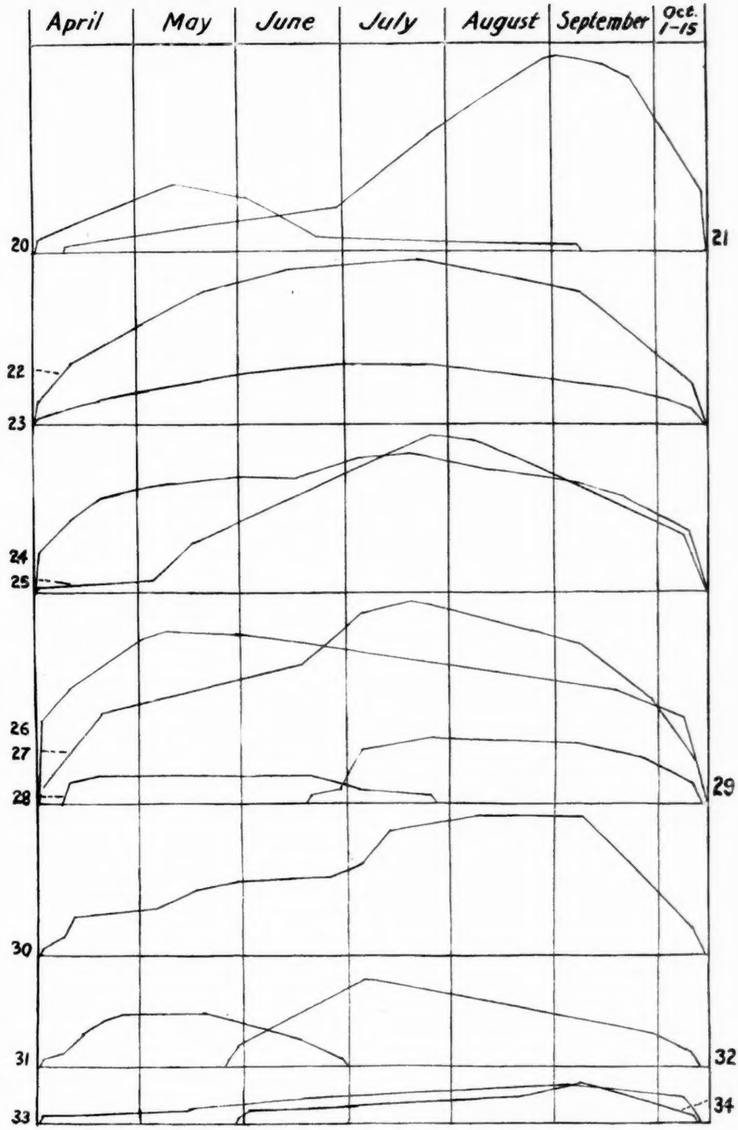
PLATE IX.


April
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August
September
Oct. 1-15
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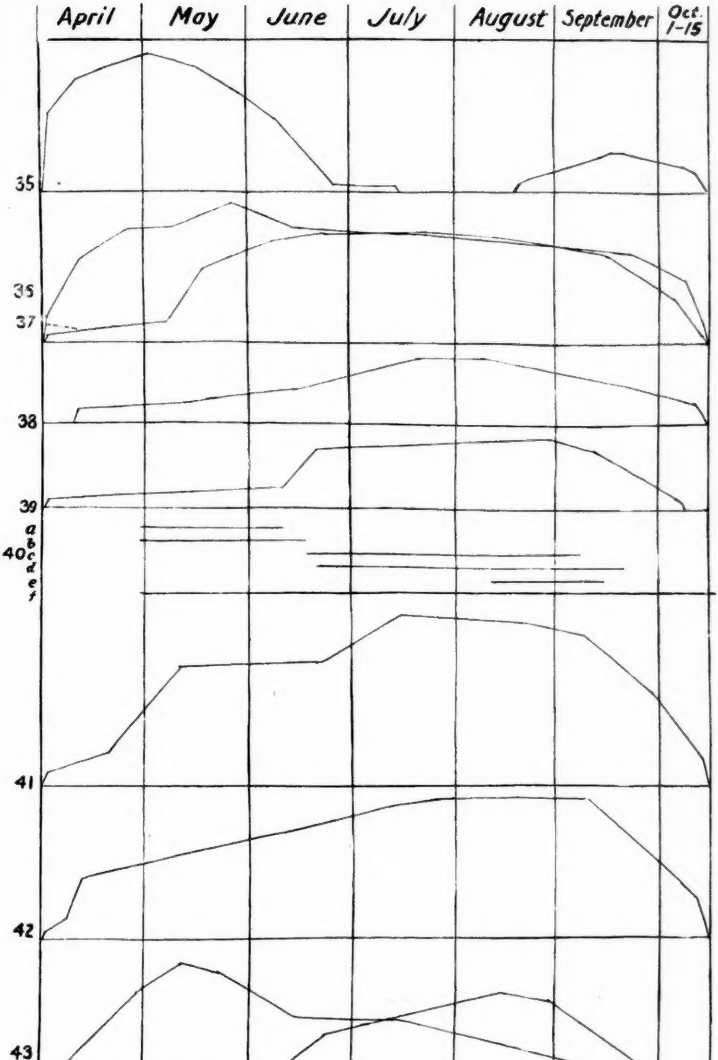
PLATE X.



April
May
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Oct. 1-15
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a
b
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and exposed pollen, especially flowers with numerous stamens. There are many flowers which have a structure of this kind and on which these bees actually preponderate over every other family of flower-loving insects. But since they do not hold a clear preponderance over the total of the other groups, it is hardly safe to call the flowers "Andrenid-flowers." The large family of flower-flies (Syrphidae, Fig. 36, Plate X) has the proboscis adapted for eating pollen and for sucking, though as a suctorial organ it is not so highly specialized as in many other flies. For this reason the flowers which are best fitted to supply the Andrenidae with nectar and pollen are also the most favorable for the nectar and pollen-eating Syrphidae, and when these two families are taken together they generally show a preponderance over all other visitors, or so many that the flower may be properly regarded as adapted to them. Putting such flowers together, I find that the *ensemble* of their blooming periods forms a curve like Fig. 43, Plate X, with a strong early maximum.

There are few evident butterfly-flowers. The best marked of them are commonly visited by long-tongued bees and flies. The species which are referred to this category form a long low curve, which we will compare with the curve for butterflies (Fig. 23, Plate IX).

Fig. 40, Plate X shows the time of flight of the ruby-throated humming bird (f) and the time of blooming of the flowers specially pollinated by it.—a. the painted cup (*Castilleia coccinea*); b. the wild columbine (*Aquilegia canadensis*); c. the trumpet creeper (*Tecoma radicans*); d. the spotted touch-me-not (*Impatiens fulva*); e. the cardinal flower (*Lobelia cardinalis*). There are two early species blooming together and going out about the time that the trumpet creeper (c) comes in, and three late species. The position of painted cup (a) is peculiar, but is much more favorable than in competition with the three late species. It will be noted that two species are in competition most of the time, while it is only a short time that one is alone or three are together. The spring and autumn migration of the bird may account for the tendency of these bird flowers to form an early and a late group.

The insects which contain what may properly be called flower-loving groups, viz.; the Hymenoptera, Diptera and Lepidoptera, are the most highly specialized orders of insects. The particular anthophilous groups we have observed to have their maxima in the late summer. With the exception of the bees, which are true flower-insects, depending upon flowers and showing true mutual correlations, the flight of these insects may be more properly regarded as determined by conditions favorable for their young. Flowers and flower-groups blooming at times favorable for utilizing them should be regarded as correlated with the time of flight of the insects, and not visa versa. Of the bees we have observed that the highest specialized (Apidae) show a late maximum while the less specialized (Andrenidae) show an early maximum, which is explained largely as a result of competition of the former. In view of the fact, therefore, that the most highly specialized flower-insects are most abundant in late summer it is but natural that there should also be a preponderance at the same time of the most highly specialized flowers whose development has been simultaneous with them. In so far as it applies to insect-pollinated flowers I think we have here the answer to Mr. Clarke's question "Why should there be a correspondence between the course of the flower seasons and the system of floral evolution?"

We have observed that the group in which the fact of the correlation of a high specialization and late flowering is very conspicuous is the Sympetalae, and it must be admitted that the proposition of Mr. Clarke in regard to the late blooming of plants of southern derivation, must enter as an explanation. In his admirable work on the Metaspermae of the Minnesota Valley, Mr. MacMillan has shown that the Sympetalae (Metachlamydeae) are especially characterized by a north-bound movement.

Throughout this paper it has been implied that the time of blooming was determined by the flight of the pollinating insects and also determined and limited by the competition of plants one with another. In verification of this view turn to the case of introduced plants. It is well-known that intro-

duced plants seem to flourish much more prosperously than the natives, and this is explained as owing to the fact that in a new country they escape the competition of forms which have been constantly undergoing modification to hold them in check. Many of our introduced plants, however, are not characterized so much by the facility with which they crowd out native species as by their habit of adjusting themselves to conditions induced by man, and of filling places rendered by him unoccupied; and in this work many of them no doubt have undergone a course of selective training in older lands. But it is sufficient for our purpose to start with the fact that introduced plants are to a great extent relieved from the pressure of competition which holds among the indigenous plants, and, therefore, as regards blooming, would be expected to flower longer. And this is in fact the rule. In those genera in which we have both indigenous and introduced species the former bloom for a short time (*Sisymbrium canescens, Stellaria longifolia, Cerastium nutans*, sunflowers, thistles) while their introduced congeners bloom much longer (*Sisymbrium officinale, Stellaria media, Cerastium vulgatum, Helianthus annuus, Cnicus lanceolatus*). The introduced species of Cruciferae, Caryophyllaceae, Portulacaceae, Malvaceae, Leguminosae, Umbelliferae, Compositae, Scrophulariaceae, Labiatae and Polygonaceae present cases of long blooming which are not equaled by any native species of the respective families.

Some native plants which have a strong tendency to occupy waste grounds also show a tendency to bloom for a long time. A similar disposition is manifested in the cases of plants having small flowers infrequently visited by insects and often self-pollinating. Many originally aquatic plants and others which have been forced to take to the water are, like introduced plants and the degraded entomophilous flowers, relieved from the severer competition of terrestrial plants and in a similar way show a tendency to prolong their blooming periods.

In the case of the indigenons flora there is a well marked disposition to limit the blooming period in anticipation of the advancing winter. The direct effect of cold is not obvious, but there is an evident tendency not to prolong the period

until the conditions should become unfavorable for the perfection of the fruit. In the case of the north bound groups (Sympetalae especially) we might infer that the northward movement would retard the blooming time so as to make it later in beginning, and to prolong it far into the autumn. I have thought that this might have something to do with the late preponderance of these groups. The curves for Labiatae (Fig. 13, Plate VIII) Compositae (Fig. 21, Plate IX) and Leguminosae (Fig. 15, Plate VIII) seem to show the influence of the approaching cold to an unusual degree, for they fall off quite suddenly from the late maxima. In the case of introduced plants we have observed that they show in a low degree the limitations which beset the indigenous species and so tend to prolong their periods. The advancing winter brings conditions, however, which they cannot escape, and it is but natural that they should show the direct effect of cold more than the indigenous plants. They form a low curve which is relatively higher at the 15th of October than any other curve. Although only about one-tenth of the entomophilous species, the introduced species show two-fifths of the flowers in bloom at the middle of October. Their blooming time is actually cut short by the cold.

An interesting fact in regard to the curves for the dominant groups of flowers is that they decline towards June. In the curves for the general flora and the Choripetalae and its groups (1–5) it will also be observed that there is a depression in June. The same occurs in Scrophulariaceae (Fig. 19, Plate VIII), while the Leguminosae (Fig. 15, Plate VIII) show an actual gap, as far as I have observed. This results mainly I think from the appearance of the dense shade in the woodlands, which limits the blooming seasons of the vernal woodland species. No plant can become a strong competitor of the vernal species unless it blooms early enough to fill out its season before the shade appears. The late species are thus required to modify their seasons so greatly before they are prepared to enter the vernal woodlands that the trees finally become as effectual a barrier against them as against the late blooming of the early species. Suppose that the Compositae should give rise to an

early flowering group which should enter the woodlands and become competitors of the spring flora, as *Antennaria* and some species of *Erigeron* now do. The curve for Compositae would finally show a June depression. These conditions must always keep the groups from taking the positions required by Mr. Clarke's theory.

INSANITY IN ROYAL FAMILIES. A STUDY IN HEREDITY.

By Alice Bodington.

In the Section of Psychology at the annual meeting of the British Medical Association, 1894, a most interesting and suggestive paper was read by Dr. W. Lloyd Andriezen, on the steady increase of the whole group of neuroses. In this paper the following sentence occurs; "Nature stamps out the insanities herself; they end in sterile idiocy. But before such a consumation can be reached, a vast and interesting progeny has to be gone through, exhibiting all the intermediate phases of the insanities and the criminalities." Dr. Andriezen speaks of the conclusions to be drawn from the history of the notorious "Jukes family" in America, and promises to enlarge on this subject in a forthcoming paper.

Now, it is doubtless almost impossible to overestimate the importance of the study of the Jukes family as an example of inherited degeneration and vice amongst the dregs of society. But, as I read Dr. Andriezen's paper, a subject for a study of hereditary insanity at the opposite pole of the social system, suggested itself to me; namely its effects in the royal families of Modern Europe. For many hundred years the problem of hereditary insanity has been worked out in some of these families, and under circumstances which enable a student to follow out all its intricacies, since the connection of members of royal houses can, for obvious reasons, be more readily traced than those of private individuals.

The subject has interested me ever since I saw, many years ago, the great grandchild of a king suffering from the most violent form of mania I ever beheld. In this case the hereditary taint had passed through two generations without development, whilst the ancestor, in whom insanity can first be traced, was a contemporary of Henry the Eighth! Moreover the insanity of this ancestor partook of exactly the same char-

acter as that of his descendant in Windsor Castle two hundred years later. It is written of the "good Duke William" of Celle that when" in old age he was deprived of both sight and reason, he had occasional glimpses of mental light, when he would bid his musicians play the psalm tunes which he loved."

In this article I will speak chiefly of the Spanish and Austrian branches of the house of Hapsburg; and of the Russian house of Romanoff.

The Spanish Hapsburgs. In the year 1496 Joanna, second daughter of Ferdinand of Aragon, and Isabella of Castile, was married to Philip the Handsome, Son of Maximilian, Emperor of Germany, and Mary of Burgundy, daughter and heiress of Charles the Bold. It is to be doubted if any marriage in the whole course of history has been attended with more direct consequences than this, since Mary of Burgundy brought with her the fairest provinces of the Netherlands as her dower, which were thus exposed to the diabolical cruelty and bigotry of Spanish rule.

In 1506 Philip the Handsome died, as lately discovered historical documents appear to prove, from poison administered by his wife. Joanna, who had always been weak-minded, was possessed by an insane jealously of her husband, and after his death she became completely mad. Fits of fury alternated with melancholy, and the sad life of this ancestress of long lines of kings ended in complete dementia. Joanna's jealously of her husband did not cease with his death, but for years she persisted in carrying his body about with her, and violent accesses of fury occurred if any woman approached the corpse.

It is not likely that the insanity in the royal family of Spain began with Joanna, and it would be peculiarly interesting in this and other cases to trace the taint from its very beginning.

Joanna's sister Catherine was the mother of the "Bloody" Queen May of English History, who showed the characteristic moral insanity and ferocious bigotry of so many of the Spanish Hapsburgs. A granddaughter of Joanna's married to Duke William V. of Juliers and Cleves, went mad, and her husband shared the same fate. Her son, who was demented, died, and

so "Nature" in this instance, quickly "stamped out insanity and idiocy"; the double taint being peculiarly fatal.

Another sister of Joanna's married into the Portuguese House of Braganza and in Napoleon's time one of her descendants—queen in her own right—died raving mad. Numerous children of Ferdinand and Isabella were sickly and died young, and one is inclined to think it would have been a "crowning mercy" if all the others had shared the same fate.

But we must return to the descendants of Joanna who wore the Spanish crown. Her son, the Emperor Charles V. of Germany, was a sovereign of unusual ability, distinguished in war and still more in diplomacy. On his father's side it must be remembered that he came of a singularly healthy stock; his grandfather Maximilian had been in his youth a veritable hero of romance, brave and chivalrous to a fault, and in the guise of a simple knight errant had won the heart and hand of his bride, the richest heiress of Europe. We shall meet with a great grandson of Maximilian's who inherited all his brilliant qualities; but not in the legitimate line of descent.

But let us turn our eyes from the potentate who held the balance of power in Europe in his hands, to the man who, hardly past the prime of life, voluntarily laid down his power, and retired to spend his last years in the Convent of Yuste. Here, the melancholia which had remained latent during the earlier life of Charles V., gradually took possession of him. He insisted that his funeral obsequies should be performed, and the prayers for the dead read for him as he lay in sackcloth and ashes in his coffin in the convent chapel.

From the shock of this ghastly ceremony the once powerful Emperor never recovered; a fever took possession of him and in a few days he breathed his last.

His successor, Philip II, was one of the most gloomy and ferocious bigots the world has ever seen. Like a poisonous spider in its web, so from the palace prison to the Escurial, did this cruel and treacherous despot devise blackest ruin and death, with one stroke of his pen condemning a whole nation to death. A determined attempt was made to carry out this incredible sentence, which was only frustrated by the most

heroic bravery on the part of the doomed people. The case of Philip II may perhaps justly be considered one of moral insanity, for to the very end of his career he never showed the slightest consciousness of having done evil. Dying by inches in the slow torture of a most horrible disease, he displayed the utmost patience, fortitude and resignation to the will of God; his end was that of a saint and a martyr as he fixed his last expiring glances on the image of his crucified Saviour. This man who had caused rivers of blood to shed, who had brought fire, famine, torture and death in its most hideous forms to countless thousands of his fellow-creatures; who was treacherous to friends and foes alike; who was privy to the death of his own son; died in absolute peace with his conscience and his God! Those who ascribe infallible and divinely instilled instincts to conscience would do well to study the career of Philip II.

The career of Don John of Austria, half-brother to Philip II, may be noticed here, as illustrating the advantages of change of environment and of fresh blood where insanity is latent in a family. He was the son of Charles V by Barbara Blomberg, daughter of a respectful citizen of Ratisbon, and in his moral and mental qualities closely resembled his great grandfather, Maximilian, whose romantic early career earned him the title of the last of the knights-errant. His singularly brilliant career was ended by his too early death at the age of 33; the victim indirectly, if not directly, of the cold and cruel policy of his half-brother Philip II. As a mere youth, Don John of Austria had gained one of the decisive battles of the world, in the naval victory of Lepanto which rolled back that advance of Turkish power which was threatening the destruction of Europe. But this brilliant success raised the sleepless jealousy of his brother, and Don John was sent to the Netherlands, there to eat his heart out with repeated vexations and disappointments, purposely inflicted by the cold, crafty tyrant of the Escurial. No trace of the influence of his mad grandmother appeared in the buoyant spirits, the trusting, generous disposition, and brilliant courage of this illfated young hero.

The career of the wretched Don Carlos, eldest son of Philip II, may fitly be mentioned here. At an early age he showed a furious and wholly ungovernable temper, a delight in cruelty for its own sake and a propensity to ignoble vices; in short he displayed every characteristic of moral insanity. Thrown into prison by his brother, fits of fury, and of exhaustion from his vices were till lately judged to be the cause of his death, but modern researches show that he was one of the many secret victims of his merciless parent.

During the lives of the two sovereigns who succeeded Philip II, the sword of Damocles which hung over the royal house of Spain remained suspended, only to fall with crushing weight on the pitiable Charles II, in whom "Nature stamped out insanity in sterile idiocy." It must, however, be remarked that Nature took nearly two hundred years in accomplishing this process, even in conditions of the most unfavorable environment, and after repeated alliances with the tainted blood of Austria and Portugal. Charles II showed all the signs of the final stages of race degeneracy. Until his sixth or seventh year he was unable to stand, and was nursed on the knees of the ladies of the Court; his prognathous misshapen jaw could not be closed and he was constantly slavering; moreover his impotence, whilst it did not prevent the immolation of two young princessess as his nominal wives, was so well-known in Europe that intrigues, with regard to the succession to the Crown of Spain, went on throughout his miserable life Semi-idiotic as was his mental condition, he was capable of suffering all the mental tortures that superstition could inflict, and his dying bed was surrounded by venal priests who threatened eternal damnation if his successor were not named according to their desires. So ended the direct male line of the Spanish Hapsburgs, descendants of the mad Joanna through her eldest son.

The Austrian Hapsburgs. The history of the Austrian Hapsburgs, descended from Joanna through her second son Ferdinand, presents much brighter features than those of the Spanish house. It is difficult, if not impossible, to apportion the share which the pernicious teaching of the Jesuits and the

gloomy traditions of the Spanish Court had in forming the characters of the two Monarchs of the Austrian line, who remind one respectively of Don Carlos and Philip II; or how large a share might be ascribed to hereditary taint.

Rudolf II (1576—1612) was the son of Maximilian II, one of the most enlightened and honorable princes of his time, and one who, strange to say, held the balance scrupulously even between his Protestant and Roman Catholic subjects. But Rudolf, unfortunately for himself and Germany, had been trained in the gloomy Court of Spain, and was a mere tool of the Jesuits. His temper was moody and variable, and he was subject to outbursts of uncontrollable passion, followed by abject submission to his advisers, the Jesuits, who had gained complete ascendancy over him.

If in Rudolf II we meet with many salient characteristics of Don Carlos, so in Ferdinand II. we have a type of character as inexpressibly odious as that of Philip II. To the ferocious bigotry of Ferdinand II, more than to any other cause, may be ascribed the Thirty Year's War, one of the most hideous wars that history has ever recorded. More than twelve million of people, at a moderate estimate, perished in this fratricidal strife; wolves ravened through the burnt and deserted villages; men killed their children and dug up the bodies of the dead for food; and, before its close, Germany lay bleeding and exhausted at the feet of France, and has only in this century recovered her strength. To ferocious bigotry Ferdinand added the blackest treachery and a cold blooded and diabolical cruelty. But atrocious as was his character we must remember that he, like Rudolf II was a tool of the Jesuits, then at the zenith of their power, and numbering in their ranks the most highly trained intellects of their time; whereas the cruelties and treacheries perpetrated by Philip II were spun out of his own brain.

The immediate predecessor of the present distinguished wearer of the Austrian crown was certainly of weak intellect, weeping when his physicians forbade him a favorite dish "Kaiser bin ich, und Nudeln muss ich haben" he sobbed. On another occasion his Minister hoped that the Emperor, who

was unusually silent at a cabinet council, was for once intent on affairs of state, when he suddenly exclaimed "I have sat at this window for an hour, and so many cabs, carriages and wagons have passed in that time." Not one word had he heard of the affairs of State! Yet Ferdinand was not so weak minded but that in calm times he could officiate as a crowned puppet. I think therefore we may say that the Austrain Hapsburgs have almost entirely escaped the taint of insanity; the line has produced numerous sovereigns distinguished by exceptional abilities and virtues such as Maximilian II, Maria Theresa, Joseph II, and the present Emperor Francis Joseph. On the abdication of his uncle, who wept for the dumplings, Francis Joseph, in most troublous times, was placed at the helm of State, and up to the present time, by the personal affection and the confidence he inspires, and by marvellous political tact, he has kept his heterogeneous dominions under his rule; perhaps the only man living who could have held such jarring elements together.

The House of Romanoff. Peter the Great, the founder of his family's greatness, presented a strange admixture of opposite qualities. One of Peter's brothers was imbecile, and the history of the Romanoff family leaves little doubt that there goes in them a tendency to insanity, latent or declared.

In Peter the Great we see on the one hand a man of extraordinary and commanding genius, whose ideas made, and still rule, modern Russia: a man who by sheer force dragged barbarous, semi-Asiatic Muscovy into the comity of European nations; and who with far seeing glance recognizing the vital necessity of a navy for Russia, did not disdain with that end in view to work as a common shipwright. On the other hand we see a drunken boor; subject to paroxyms of ungovernable fury; ferociously cruel; in a word showing the worst attributes of an utter savage.

Truly here we see the "beast within the man." But it seems as though his very superiority of brain makes the beast in man to so transcend all evil qualities of a beast of prey tha one can hardly wonder that the human imagination conceived devils as the moving agents of such horrors. No wild beast's

brain could conceive or execute the prodigies of cruelty, debauchery and lust that characterize the beast within the man where it has gained the upper hand.

There is no doubt that Peter the Great, like other great geniuses, as for instance Mahomet and Napoleon, suffered from epileptiform attacks, and in his fits of frenzy was not responsible for his acts. Another factor may be taken into account in estimating the character of Peter the Great, namely his prolonged bouts of drunkenness, during which he would swallow incredible quantities of brandy. In these orgies Peter would find pleasure in pouring brandy through a funnel down the throat of some wretched courtier who had succumbed sooner than himself; a practical joke ending in the death of the victim. But the most gruesome incident in the life of Peter the Great was the death of his son Alexis. Alexis much resembled the ill-fated Don Carlos; his wife, a German princess, after five years of misery refused medicine and food, and was glad to find an escape in death; he was violently reactionary in his opinions, and Peter honestly believed that his hardly won reforms would be utterly undone if Alexis were his successor. But after the discovery of a formidable plot on the part of his son, Peter, determined to extort the whole truth, ordered Alexis to be flogged. Finding no one who would venture to execute his commands, Peter, mad with rage, proceeded to flog Alexis, (as he used formerly to flog his first wife,) till he left the wretched prince for dead on the floor; when he stalked out exclaiming "You need not alarm yourselves, the devil is not ready for him yet." During the next twenty-four hours the miserable sufferer was again twice flogged, and under the third application of the knout he died. The father's repentance was terrible and lasting; as chief mourner he followed his mangled son to the grave, crying as David did for Absalom, that he would willingly have died for his son. And when he again lashed himself into insane fury, it was to wash out his son's death in the blood of those who had tempted him to crime.

The next sovereign who calls for remark, Peter III, was grandson of Peter the Great through his daughter Anna. If

we say that Peter III repeated every vice of his grandfather's without any of his virtues we shall have said almost enough; he was a drunken, madly vain, dissolute savage, and after being dethroned, was assassinated by the orders of his wife, Catharine II.

Paul I was not unlike Peter III in his general characteristics, and he too was assassinated. Alexander I, the rival of Napoleon, presents the greatest of contrasts to the Romanoffs we have hitherto seen; he inherited the excellent qualities of his mother, Catherine the Great, whilst he was a stranger to her vices. Like Joseph II of Austria, he was too enlightened for his environment; his schemes for good were frustrated; his noblest hopes for his country disappointed; a deep melancholy settled on his spirits, and like Joseph II he welcomed death.[1]

The character of Alexander I was nearly repeated in that of Alexander II, his nephew, the "Tzar Liberator." As we survey the men of the Romanoff family in the present century, though we find many of its collateral members showing an undesirable atavism, yet the actual wearers of the Russian crown, with all their mistakes, must be credited with the honest intention of doing their best for their people. In short the final result shows that a ruling family may have a worse ancester than a drunken epileptic, who was at the same time a man of supreme genius! Unfortunately the race, once so strong, has been tainted through the female side with consumption, which promises to play worse havoc in two generations than epilepsy or drunkenness in two hundred years.

I can offer here only a slight and imperfect sketch of the lives on which a more fortunately situated enquirer might work. I have alluded only to the best known direct lines of succession, but a wide field of interest lies before the student who will follow the ramifications of European royal families through the female side. There have been constant intermarriages between the Hapsburgs and the Bourbons. Perhaps it is not too far-fetched to ascribe the superior abilities of

[1] "I am dying," said Joseph II, when his benevolent schemes for the good of Hungary had been utterly frustrated, "My heart must be made of stone not to break."

the House of Orleans to marriages which brought fresh blood into the family; whereas the alliances of the elder branch of the House of France were of the nature, known to stock raisers as "breedings-in-and-in."[2]

In any case it would be worth while to trace carefully—so far as possible—the origin of the characteristics of the French, Spanish and Neapolitan Bourbons, as compared with those of the House of Orleans: the three former bigoted, unprogressive, unable to assimilate the advanced ideas of their age; having after the French Revolution "learned nothing and forgotten nothing," and the House of Orleans descended from the younger brother of Louis XIV, abreast of all the ideas of their time, highly intelligent, cultivated and progressive. In the house of Orleans we are watching a rising family; in the other branches of Bourbons, families mentally and morally sinking.

Another interesting branch of enquiry, would be to trace the origin of the insanity in the Danish, Bavarian and Belgian royal families. The curious coincidence between the form of insanity which characterized the good Duke of Celle in the sixteenth century, and that from which his descendant, George III, suffered two hundred years later, I have already alluded to. But why did the taint of insanity remain latent for so many years, and can some marriage be traced which caused its recrudescence? I think it might be found in the family of the Princess of Wales, mother of George III; but I have no means here of tracing the lineage of that princess.

But having started this train of enquiry with the intention of cursing the whole group of Neuroses, as productive of in-

[2]Phillippe brother of Louis XIV married Charlotte Elizabeth of Bavaria; one of the most strong minded and original personalities of her time.

Philippe's only son married a natural daughter of Madame de Montespan's; and had his ears soundly boxed by his mother when she heard of the engagement. Louis-Phillippe-Joseph 1747—1793, married the only daughter of the Duc de Penthievre.

The mother of the late Comte de Paris was a Princess of Mecklenburg.

On the other hand Louis XIV, elder brother of Philippe, first Duke of Orleans, married the only daughter of Philip IV of Spain; Louis XVI married Marie Antoinette of the Austrian House of Hapsburgs, and the direct male line became extinct with the intensely narrow and bigoted Comte de Chambord, whose mother belonged to the Neapolitan branch of the Bourbons.

calculable hereditary evils, I find myself by no means, Balaam-like, "blessing them altogether" but arriving at the conclusion that with ordinary care and discretion the tendency to mental instability is not more mischievous, than the taint of strumous disease, of syphilis, of cancer,—in short of any of the other Protean ills with which civilized society is permeated. Fortunate indeed is the family which comes of a good, hearty, gouty stock; amidst a choice of evils this tendency to gout seems one of the least!

It also appears to me that the attempt to "stamp out" insanity, though it may seem easy on paper, would prove impossible in practice. There is an unfortunate correlation between various forms of disease which would oblige society to stamp out the greater part of the civilized portion of the human race, if a serious effort were made to stamp out insanity, one member of a strumous family may develop disease of the lung; another succumb to cerebral meningitis; a third become insane. The child of a drunken father may become insane or be a habitual drunkard, but he may also, if the drunken father be Philip of Macedon, prove an Alexander the Great. The child of syphilitic parents may develop a train of ills of which insanity may be one; or the hereditary taint may leave one generation untouched and destroy the next, as in the case of the House of Valois. You can drown the weakest puppy or kitten in a litter, but if you destroy your physically weak human beings, you may put an end to a Newton, a Voltaire or a Walter Scott. What human being, unendowed with supernaturel discernment, could tell where the stamping out was necessary?

One line of action only appears safe and practicable, and it is one which find an increasing number of advocates; namely the Sterilization of the Unfit. I do not use this expression in the sense of surgical interference, though this course is also often advocated; inevitably injustices would be done, mistakes would occur, ending perhaps in death; public opinion would be aroused, and no one would be allowed to interfere with the marriages of criminals and imbeciles for some generations to come. But what must necessarily be done if society is not to be swamped with the criminals, the idiots, the imbe-

ciles, the congenitally defective, which she now so sedulously cares for, is that the unfit should be kept under kindly but strict supervision; the sexes strictly separated, and a *life long surveillance* kept up. And for practical purposes no cognizance can be taken of the Unfit till they are or become chargeable to the State. An expensive and troublesome course, it may be said, but what is the expense of the life-long care and surveillance of the present generation of the Unfit, compared to the incalculable expense and mischief of allowing them to propagate their species without check?

For conclnsion I hope any readers who may be interested in the subject of this paper, will read an article in the Arena for November 1894, entitled "The Relation of Imbecility to Crime," by Martha Louise Clerk. This lady speaks from a wide practical experience of the care of imbeciles, and she eloquently expresses opinions, much like those I have arrived at, upon more theoretical grounds.

THE SIGNIFICANCE OF ANOMALIES.[1]

BY THOMAS DWIGHT, M. D., LL. D.[2]

This subject, which after consultation has been chosen for our discussion this year, is one which for a long time has interested and puzzled me extremely. I look forward with great pleasure to the light which I hope will be thrown upon it by distinguished members of this Association. For my part I propose merely to state some of the difficulties which it seems to present and suggest one or two general conclusions which seem to me to be justified.

Probably no biological phenomena have been more confidently explained by heredity and atavism than rudimentary organs and anomalies. The former, of constant occurrence, though perhaps of transitory existence, have been happily compared by Darwin to letters in words which are no longer sounded, but which were pronounced at an earlier stage of the language.

Anomalies are the occasional appearance of structures normal in other animals. That these are found very commonly in man everyone knows. Whether they are found equally commonly in animals is a matter of uncertainty. Mr. Dobson believes that man as the type of a domesticated animal is particularly liable to them and that in wild animals they are extremely uncommon. To this may be opposed the great frequency of anomalies in negroes. If I am not mistaken, other rebutting evidence is furnished by comparative anatomy. The same explanation has held for these; but as their gradually increasing numbers have brought more accurate study, serious difficulties have arisen. It is clear that if an anomaly in man is to be called a reversion, either the species in which it is normal must have been in the direct line of ancestry, or there must have been a common progenitor. Evident as this

[1]Read at the meeting of the Association in New York on December 29th, 1894, to open the discussion.

[2]President of the Association of American Anatomists.

is it has been grossly disregarded, not only by popular scientists, but by some from whom better might be expected. To point out the animal in which a certain anomaly is normal has been too often offered as an explanation. Critical study makes many difficulties apparent. These are vastly increased when we consider that a satisfactory explanation must account not only for certain anomalies, but for all. At the very least there must be no case clearly at variance with the explanation.

All anomalies have not the same significance. Certain ones represent structures widespread throughout mammals, some of them even in other classes of vertebrates. Three of these may be mentioned: the supra-condyloid process, the third trochanter, the para-mastoid process. Of the first there is usually no trace in man. The second is represented at most by a roughness of doubtful interpretation, in my opinion it is usually wholly absent. The third is wanting, or a mere point. The occurrence in man of a third trochanter is very common, that of the supra-condyloid process uncommon and a really large para-mastoid process is a great rarity. None of them occur normally in the Simiidæ (the anthropoid apes). Of these structures the most general is the supra-condyloid foramen. In the primates it is practically universal among the Lemuroidæ, but among the Anthropoidæ it occurs only among some of the smaller monkeys,—some of the Cebidæ.

The third trochanter also is almost universal among the Lemuroids as a rudiment, and in some species reaches a moderate development. There are traces of it in some of the smaller monkeys, and it is occasionally seen in the gibbons and the chimpanzee. I have tried to maintain that the true third trochanter in man, occurring very often on delicate bones, is different from the rough line for the insertion of the glutæus maximus.[3]

The para-mastoid process is, if I am not much mistaken, rudimentary or wanting throughout the primates.

When therefore, we find a supra-condyloid process which with the completing ligament, represents the supra-condyloid foramen, to account for it atavistically the shortest leap is to

[3]Journal of Anat. and Phys. Vol. XXIV.

the Cebidæ. In the case of the third trochanter we can hardly stop short of the lemuroidæ in spite of the probability that they and the anthropoidæ came from a common stem. For a really large para-mastoid process we must go beyond the primates altogether. There would be some comfort to be gained from the insectivora were we in the least justified in putting them among the ancestors of the primates, for several genera have a well-developed para-mastoid process, the supra-condyloid process is general, and the third trochanter is frequently represented, still it is neither general nor very prominent. For its greatest development we must turn to the odd-toed ungulata, and now descent is out of the question.

It may be opposed to this that we have no right to assume that a certain well developed anomalous process in man must necessarily be accounted for by inheritance from a form possessing an equal large one; that it is enough to show the existence of a clearly marked process in a common ancestor and to assume that its great development in the anomaly is an accident of no significance. I am quite willing to grant that this objection has weight. Still when we account by atavism for the supra-condyloid process we must admit that the gulf between the structure of man's body and that of one of the Cebidæ is so great that this explanation would hardly serve were it not absolutely necessary for a theory.

Another class of anomalies are those, which far from being general features, are found in certain highly specialized animals which can be included in no possible scheme of descent. An instance is the fossa praenasalis, not to be confounded with the rounding of the border of the nares which is practically universal. It occurs in human skulls of a low order and presents a development which is seen in no animal. It is usually more or less distinctly marked in the seal tribe. I have seen it poorly marked in the gorilla. Here atavism is wholly at fault. The Pronator Quadratus muscle in man very rarely sends a prolongation downwards to one or more carpal bones on the radial side of the wrist. I am not aware that this is normal in any mammal. Whence then does it come? Testut would have it the homologue of a muscle which Humphry

describes as pronator manus is Cryptobranchus Japonicus and of one described by Meckel in chelonians. It is curious that Macalister has found this arrangement in a tiger and I have found it in both arms of a chimpanzee, which I believe is an unique observation. This shows a tendency in the carnivora and primates to similar variation which is not inherited.

Some of these anomalies present a likeness that is very probably accidental, possessing no significance whatever. Such is the peculiar union of the different pieces of the sternum by which the manubrium fuses with what should be the first piece of the meso-sternum. Is the fact that this frequently occurs in the gibbons to be looked upon as anything but a coincidence? Does the occasional perforation of the thyroid cartilage by the superior laryngeal nerve in man derive any significance from the fact that this is found in the seal? Again, when we find in man some anomaly of the aortic arch or of the great arteries springing from it, we know that the usual course of development of the branchial arches has been disturbed. Need we look further than to some accident in the individual? Has the fact that the abnormal arrangement is normal in some animal any significance? These are questions which admit of no certain answer.

The second class of anomalies are those of most difficult explanation. They naturally suggest an analogy with the cases of the occurrence of similar structures in widely separated animals, such as the bill of a duck and of the Ornithorhyncus, the paddle of the cetacean and of the ichthyosaurus. The obvious retort is that these resemblances are superficial; but they are none the less true. Indeed, similar arrangements for a similar purpose are found which can in no way be called superficial. A very good example is furnished by Mr. Dobson.[4]

The Pyrenean water mole (Myogale) of the Insectivora, which has very elongated digits, has an enormously developed fibular flexor and a rudimentary tibial flexor. On the true moles the tibial flexor is larger, but the arrangement is

[4]On the Comparative Variability of Bones and Muscles, etc. Journal of Anat. and Phys. Vol. XIX. p. 20.

the same. Now the Bathyergus martimus of South America which has the habits of moles, but is really a rodent, has a precisely similar disposition of the parts. "Here the larger fibular flexor, as in Myogale, has forced the tibial flexor inwards, so that the latter is attached to the head of the tibia internal to the attachment of the popliteus; and its tendon being separated in the foot from that of the fibular flexor, is attached, precisely as in the true insectivorous moles, to the tibial margin of the basil phalanx of the hallox, developing, as it crosses the ento-cuneiform articulation, a broad sesamoid ossicle." Mr. Dobson then asks: "How happens it that in certain widely separated species, in no way connected by descent from a common ancestor having similar peculiarities, separation of this tendon from that of the fibular flexor and attachment to a different part of the foot has occurred in a perfectly similar manner?" He finds this very difficult to answer and can only suggest that the arrangement in question being the best, it has been reached independently in both species by natural selection.

Those of us who look upon natural selection pure and simple as quite inadequate to what is already required of it, will not be disposed to call upon it to do double duty. Those who like myself, believe in design and in a limited evolution founded on law, while they may explain by teleology such instances as the last mentioned, can by no means apply that doctrine to anomalies.

The mechanical theory that the action of certain muscles should account for certain processes, such as the third trochanter, is not admissable. I have shown that this anomaly occurs in savage races in which presumably all live pretty much the same life, and that further it occurs at too early an age to be caused by any strain in the individual.[5] Even were this not so there are many anomalies which obviously can have no connection with mechanics.

It is easier to destroy than to build. I can offer no substitute for the theories I reject which would itself stand criticism. I will merely offer the following as justifiable conclusions.

[5]Loc. cit.

First, similarity of structure, either in the ordinary animal or in the one showing variations, is not necessarily a proof of descent. Second, those very irregularities, which we call abnormal, point to a law in accordance with which very diverse animals have a tendency to develop according to a common plan. This be it noted, in no way denies the possible influence of surroundings.

EDITOR'S TABLE.

THE Societies of Naturalists, Morphologists, Physiologists and Geologists met together during the late holidays in the ample halls of the Johns Hopkins University, in Baltimore. The Geologists had met previously independently of the other societies. Their presence at Johns Hopkins added much to the interest of the meetings, and permitted some exchanges of hours on occasions of especial interest. The Naturalists listened to an excellent address from the retiring president, Dr. Minot, and had an instructive debate on the influence of the environment on animal life, conducted by Messrs. Osborn, Hyatt, Brooks and Merriam. Impressive papers were read before the Morphologists by Drs. Wilson and Hyatt; the former embryological, the latter paleontological. Three of the societies sat down to dinner at the Stafford House on Friday evening, and did justice to the exceptional hospitality of the host, Mr. Moale, himself a graduate of Johns Hopkins. The place of next meeting has not been decided on, but it is hoped that it will be such as will suit the convenience of several societies additional to those that met at Baltimore. These are the Anatomists, who met this year in New York; and the newly organized societies of Botanists and Psychologists.

These bodies all consist of actual workers in their respective fields, and they are, therefore, with a few others, the only scientific societies in this country in which strict qualifications are requisite for membership. Our contemporary, the American Geologist, in a recent editorial article, advocates the establishment of academies of science in the several States of the Union, as was done by the NATURALIST many years ago. It points to Indiana as furnishing an example worthy of imitation, since the legislature has made an appropriation for a biological survey of the State, to be conducted by its Academy of Science. The prime condition of prosperity for an academy of science must always be the effective character of its membership. This will always be especially important where State aid is granted. Some practical test of fitness for membership is necessary. One such test would be membership in one of the affiliated societies referred to above. A State Academy of Science composed of all the members of these societies resident within its borders, would be a very effective body.

SCIENTIFIC exploration is becoming popular in the United States as the desire to extend knowledge increases. Apart from Government

expeditions, Philadelphia was for a long time the centre of activity of this work, as the Arctic expeditions of Kane, Hays and Peary and the South American expeditions of Orton and Smith testify. Abbott and Donaldson Smith the African explorers, are Philadelphians, as is also Rockhill, who traversed Thibet and China a few years ago. Ann Arbor University has sent two expeditions to the Philippine Islands, and Iowa University sent one to Central America, and one to the Arctic regions northof Mackenzie's River, of which we gave an account in the last number of the NATURALIST. New York sent Rusby to Bolivia and Peru, and more recently Weber to Java. There have been several expeditions nearer home, as to the West Indies and Labrador and Central America. We do not refer to Government expeditions, which were more frequent formerly than of recent years.

RECENT LITERATURE.

The Mesozoic Echinodermata of the United States.[1]—This memoir, issued as Bulletin No. 97 of the U. S. Geol. Survey, is the first of a series of reports on the American fossil radiates. A complete bibliography of the subject is followed by a systematic review of the various forms, in which brief descriptions, giving merely the characteristics necessary for accurate determination of species, is the rule. The geological range of the American Mesozoic species is shown in tabular form, and, in conclusion, there is an index to the various terms employed by those who have written upon the Mesozoic Echinodermata of the United States.

The memoir is profusely illustrated, the plates, 50 in number, occupying over half the volume. Many details of structure not given in the text are shown in the drawings. This book fills a need, as no general work on the subject exists, but students were compelled to search through a much scattered literature for information and identification.

Tertiary Rhynchophorous Coleoptera of the United States.[2]—This monograph is the first of a series upon the fossil insects of this country by Dr. S. H. Scudder. In its preparation, besides a number of specimens which could not be definitely placed, the author has examined 753 Rhynchophora, of which 431 come from Florissant and 320 from the Gosiute fauna. In the introduction Dr. Scudder gives in tabular statements (1) a comparative view of recent and fossil Rhynchophora; (2) the relative importance of the families of group; (3) the relative abundance of the orders of insects in different Western deposits.

In conclusion the author makes the following statements regarding the Rhynchophorous fauna of the American Tertiaries in general:

"(1) The general facies of the fauna is American, and somewhat more southern than its geographical position would indicate.

"(2) All the species are extinct, and though the Gosiute Lake and the ancient lacustrine basin of Florissant were but little removed from

[1] The Mesozoic Echinodermata of the United States, by W. B. Clark. Bull. No. 97, U. S. Geol. Survey, Washington, 1893.

[2] Monographs of the United States Geological Survey, Vol. xxi. Tertiary Rhynchophorous Coleoptera of the United States, by Samuel Hubbard Scudder, Washington, 1893.

each other, and the deposits of both are presumably of Oligocene age, not a single instance is known of the occurrence of the same species in the two basins.

"(3) No species is identical with any European Tertiary form.

"(4) A very considerable number of genera are extinct, often including a number of species.

"(5) Existing genera which are represented in the American Tertiaries are mostly American, not infrequently subtropical or tropical American, and where found also in the Old World are mostly those which are common to the North Temperate Zone. A warmer climate than at present is indicated.

"(6) There are no extinct families, but in one instance an extinct subfamily with numerous representatives.

"(7) The Tertiary European fauna is nearer than our own Tertiary fauna in the relative preponderance of its families, subfamilies and tribes."

"These conclusions are almost identical, word for word, with those reached from a study of the Tertiary Hemiptera of the United States, although in that study a far more meagre representation of the Gosiute fauna was at hand."

The Fishes of Pennsylvania.[3]—In an octavo volume of 139 pages Dr. Tarleton Bean gives in a concise form descriptions of all the species of fishes found in the State of Pennsylvania, with notes upon their common name, distribution, size, habits, reproduction, rate of growth and mode of capture. The descriptions are based upon specimens contained in the collection of the United States National Museum, and the popular notes have been obtained by personal investigation and, in part, by compilation from the writings of Goode, Gill, Cope and Jordan.

The most important fishes are represented on 35 plates, of which 15 are handsomely colored. Dr. Bean's well-known reputation as an ichthyologist is fully sustained by this work, and it fully justifies the State in incurring the expense necessary to its publication. Its value is both utilitarian and educational.

[3] The Fishes of Pennsylvania, by Tarleton H. Bean, M. D., Harrisburg, Pa., 1893.

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General Notes.

GEOGRAPHY AND TRAVELS.

An Expedition to Labrador.

Some scientists and explorers have devoted considerable time and attention to the exploration of certain sections of Labrador, notably Prof. Packard, Mr. Stearns, Prof. Lee, Henry G. Bryant and Mr. A. P. Low, of the Dominion Geological Survey.

The reports and writings of these men interested me so deeply that I resolved to devote a summer to exploring in Labrador, and so I organized a small party last June, with the intention of visiting the interior table-lands of the peninsula by way of Hamilton or Grand River, already explored by Mr. Bryant to the Grand Falls. The party, besides myself, consisted of Mr. Howard Bucknell, ornithologist; Mr. G. H. Perkins, geographer, and Mr. G. M. Coates, botanist.

We got together a complete camp outfit, two Rushton canoes for use on the rivers, a set of surveying instruments, collecting materials, etc., and thus equipped we took passage with "Dr. Cook's Arctic Expedition of 1894," on the steamship Miranda, since famous on account of the numerous accidents which befell it, and its final abandonment in Arctic seas.

We left New York on July 7th last, and enjoyed a pleasant voyage to North Sydney, Cape Breton, where we stopped to take in a supply of coal. Here we visited the copper mines and the great coal mines, which extend for miles beneath the sea. From Sydney we went on to St. Johns, N. F., where we stopped for a few hours in order to repair one of our compasses. Two days after leaving St. Johns, a quarter after eight o'clock on the morning of July 17th, the steamer, being surrounded by a heavy fog, collided with an iceberg. Great commotion arose among the passengers, which, however, quickly abated, for it was discovered that no serious damage had been inflicted. It was decided to put into Cape Charles, on the southern coast of Labrador, for repairs. Here we remained for several days, and devoted ourselves to making collections of the flora and fauna of this section. The country about Cape Charles is composed of low hills formed of granite, syenite and hornblende. The student of geology will find here trap-dykes and veins of various kinds, also remarkable examples of anticlinal and synclinal strata exhibited on the eroded surfaces of the

almost perpendicular cliffs along the shore.. The country is almost destitute of trees, but there is a great profusion of mosses, principally sphagnum, and reindeer moss abounds. We procured here a beautiful specimen of the Canadian lynx (*Lynx canadensis*), but saw no evidences of small mammals other than the rabbit (*Lepus americanus*), of which two specimens were procured. We saw several seals, but did not have the good fortune to capture any.

As the Miranda was obliged to return to St. John's for further repairs, we embarked from Cape Charles on the regular mail boat for Independent Harbor, the entrance to Sandwich Bay, about sixty miles south of Hamilton Bay, where I had originally intended to begin my explorations. I was obliged to change my plans on account of the accident to the Miranda, and the illness of Mr. Bucknell, who had been taken sick shortly after leaving New York. When we arrived at Independent Harbor we secured passage in a small boat to Separation Point, a narrow point of land separating the White Bear from the Eagle River. Here we made a cache of our provisions, and, with our two small boats, started to explore the White Bear River. On the second day out from Separation Point we came to a considerable cataract, sixty feet in height. Mr. Bucknell's condition was now so serious that I deemed it unwise for him to proceed any further, and so I pitched camp at the foot of the falls, and left him in charge of Mr. Coates, to collect ornithological and botanical specimens, while Mr. Perkins and myself took the smaller boat, and provisions for ten days, and went around to explore the river. We ascended it to a distance of about one hundred and ninety miles from its mouth. We found the streams at this season of the year very shallow, with numerous rapids, which rendered its ascent extremely difficult. Frequently we were compelled to remove our trousers and boots and push the boat along, the water not being deep enough to float the boat while we remained in it. After passing a rapid, or rattle, as it is called by the half-breed Labradorians, there was usually quite an expanse of water extending for some distance ; this is called by the natives a "stiddy." Our progress along these "stiddies" was comparatively easy. About fifty miles from the coast, and on either side of the river, rose hills and peaks from 1400 to 1600 feet in height. These were covered with a dense primeval growth of spruce and tamarack, with an occasional clump of birch-trees, and great beds of moss from a foot to three feet in depth. Great numbers of dwarf cornel (*Cornus canadensis*) abounded. We came across numberless erratic boulders of labradorite, as well as other boulders of all sizes, which lined the bed and sides of the stream.

As we penetrated into the interior of the country and neared the source of the river, the physical aspect was entirely changed, owing to the absence of forests and the less variety and abundance of moss. The boulders increased in numbers, and were covered with lichens of various kinds. After we had made the first fifty miles we saw no evidences of animal life whatever. The river terminated in a chain of small lakes. On either bank we found vegetation, principally willows, all bent down stream, and the bark scarred and scratched, indicating that the water in the spring of the year had risen to a height of eighteen or twenty feet. At the lower portion of the river we found peculiar semicircles of boulders, ranging in size from the dimensions of a hen's-egg to two and three feet in diameter. We learned that this fantastic arrangement of the boulders was due to the peculiar action of the ice during the spring, the boulders being transported by the ice and dropped in this position by eddies. At first we thought that these peculiar circles of stones might have been arranged by the early inhabitants of Labrador.

When we returned to camp we found that Mr. Bucknell's condition had not improvod, though he and Mr. Coates had managed to make a very creditable collection of birds and plants. After a day's excursion on the south fork of the White Bear River we returned to Separation Point. I sent Mr. Bucknell over to Cartwright, the most southern and eastern Hudson Bay trading-post on the Labrador shore, and, with Mr. Perkins and Mr. Coates, continued the exploration of the Eagle and Paradise Rivers. We found the Eagle River much deeper, narrower and more rapid than the White Bear, and only about half as long. The Paradise River was very broad in comparison with the other two, as it flows through a more level section of the country. Here we found an abundance of plants which did not grow in the more mountainous districts, and we came across a number of large lakes, upon which were a great many species of water-birds not before seen on the trip. We ascended this river only about forty miles.

Lining the banks of the river were dense growths of willows; but these did not show in any way the effects of high water. We found seals all along the river as far as we went, and procured about twenty skins, principally of the Harbor seal (*Phoca vitulina*), though we also captured specimens of the *Phoca fœtida*, *Phoca hispida*, *Phoca grœnandica* and *Cistophora cristata*.

This river, like the Paradise and Eagle, abounded with trout and salmon, which afforded us rare sport and kept our table well supplied.

On the north side of Sandwich Bay is a mountain 1900 feet high, on which caribous (*Rangifer caribou*) are very abundant. We ascended this mountain and shot several specimens of caribous, and also found here a vein of labradorite outcropping on the surface that measured forty-two feet in length and three feet in width, with a dip of 47° east of south. We also found small veins of mica and great quantities of iron ore, also copper in the form of malachite. Hornblende, gneiss, syenite and granite were the principal rocks. We also came across great quantities of small crystals of garnet, some of them very pretty. In several places surrounding Sandwich Bay, and on each of the rivers we discovered glacial striations running southeast in direction. Some of these were ten or twelve feet long, and were distinctly cut in the smooth, polished surface of the rocks. At Cartwright, and, in fact, throughout the section that we explored, we found but few full-blooded Eskimos. The inhabitants of southern Labrador are a mixed breed of people, Eskimo mixed with various nationalities, mainly English and Danish.

The Labrador waters are noted as among the greatest fisheries in the world for cod and salmon. There are about 25,000 fishermen along these shores, who come chiefly from Newfoundland, and depend wholly upon fish for their living. This past year the fisheries have been a total failure, both in Labrador and off the coast of Newfoundland. Great suffering has been reported from Newfoundland, but from the condition of affairs we saw in Labrador the sufferings of the Newfoundland fishermen must be slight in comparison to those of the destitute Labrador people.

Just before we left Cartwright on our return voyage, a severe storm took place, and nearly three hundred shipwrecked fishermen were brought to Newfoundland by the Labrador mail steamer.

The relationship of the Eskimos of Labrador to those of Greenland has been a matter of some controversy. I wish to call attention to a little fact in regard to the clothing of these two peoples, which may have some bearing upon the question of their relationship. On the lower edge of the *timiak*, or coat, of the Labrador Eskimo, in front and behind, are two ornamental appendages in the form of flaps; the anterior one is but a few inches in length, while the posterior flap reaches in some instances below the knee, being narrow at the top and gradually broadening out like a beaver's tail. This is highly decorated on the back with various colored pieces of seal-skin from which the hair has been removed, and with a border of another color from which the hair has not been removed. These flaps are

to be found among the Eskimos of Greenland, especially among those above Cape Cook. Among them, however, the posterior flap is but a few inches in length, and during the severe Arctic winters the Greenland Eskimos tie these flaps together between the legs, outside and over the *nanookies*, or trousers, and so make of them a support and a protection against the cold. The Eskimos of Labrador are more or less given to ornamentation of various kinds, while those of North Greenland are intensely practical and display no ornamentation in their dress.

The idea occurred to me that the Eskimos, in travelling northward along the American side, conceived the idea of tying these flaps between their legs, and as the people parted company and split into sections, one section retained the flaps for ornamental purposes, while another section, going still further north into Greenland, preserved the flaps for practical purposes only.

The Eskimos and Indians of Alaska, as far as I have been able to ascertain, have neither the front nor the back appendage on their *timiaks*. However trivial this suggestion may seem, I wish that men concerned in tracing the relationship and origin of the Eskimo tribes would give this matter some attention.

As regards our natural history collections, we obtained thirty-nine species of mammals and seventy-seven species of birds, all of which, with the exception of two species of birds, are listed by Prof. Packard in his work, entitled "The Labrador Coast."

Mr. Coates made a large collection of plants, but as yet these have not been identified. Five butterflies not given by Prof. Packard were procured. We were not prepared for marine collections, but, nevertheless, we secured a number of echinoderms, one of which was a magnificent twelve-rayed star-fish. Of batrachia two species were procured, *Rana septentrionalis* and *Bufo americanus*. We saw nothing of the salamander, *Plethodon glutinosus*, of which Packard speaks, nor did we see that peculiar jumping-mouse, *Zapus hudsonius*, which Mr. Bryant mentions as being so abundant along the Hamilton or Grand River. Any naturalist in search of specimens of the mosquito and black fly will find a most prolific field in Labrador. Such numbers of these pests did we encounter that I have come to look upon Labrador as the fatherland of these torments.

We left Cartwright on September 14th for Pilley's Island, off the Newfoundland coast, and here we caught the steamer Sylvia for New York. We arrived in New York on September 30th, very nearly three months from the date of our start.

CHARLES E. HITE.

MINERALOGY.[1]

Minerals from the Chromite Deposits of Lower Silicia.—Traube[2] describes serpentine, albite, chromite, kämmererite and rutile from the chrome deposits of Tampadel in the Zobtengebirge in lower Silicia. The kämmererite is found to some extent in crystals a centimeter across of greenish, reddish, or violet color, and either in hexagonal plates or in combinations of hexagonal pyramid and base. In transmitted light thin cleavage plates show a division of the field into a central uniaxial portion, and six marginal biaxial areas. The marginal areas have an optical angle of 20°–30° with the plane of the axes parallel to the marginal edge. In the same paper cerussite, Iglesiasite, Tarnowitzite, hemimorphite, pyrrhosiderite and sulphur are described from the upper Silician ore region. The cerussite is interesting because of the wealth of the crystals in forms. A crystal from the Friedrichsgrube showed nine forms including the new form a=4P (441). Another crystal exhibited eighteen forms including the two new forms f $=\infty\breve{P}7$ (170) and g $= 7\breve{P}7$ (171). Iglesiasite, the zinc-bearing cerussite, which has been known from but the one locality of Monti Poni near Iglesias in Sardinia, is found on smithsonite in good crystals at Radzionkau. The forms x (012), i (021), y (102), e (101), i (210), m (110), r (130), p. (111), and o (112), were observed and measured, the form i $=\infty\bar{P}2$ (210) being new to cerussite. Chemical analysis showed the mineral to contain 5.47 per cent. $ZnCO_3$, while that from Iglesias contains 7.02 per cent. Tarnowitzite, the isomorphous mixture of calcium and lead carbonates is studied in the original locality of Tarnowitz. The mineral is sometimes clear and colorless, but is also green, reddish-brown, or yellowish. Lead carbonate is present up to 9 per cent in some specimens. All of the four analyses made from specimens differently colored, showed the presence of a small per cent (up to 0.35) of Sr O. A number of brachydomes were observed which have not before been described upon this mineral, viz: (031), (051), (061) and (071).

Artificial Reproduction of Anhydrite from Evaporation of Salt Solutions.—Brauns[3] has produced anhydrite in microscopic

[1]Edited by Dr. Wm. H. Hobbs, University of Wisconsin, Madison, Wis.

[2] Zeitschrift d. deutsch. geologischen Gesellschaft, xlvi, pp. 50–67, 1894.

[3] Neues Jahrbuch, f. Min., etc., 1894, (II), pp. 257–264.

crystals by bringing upon an object glass a large drop of a saturated solution of sodium or potassium chloride or a mixture of the two salts, and placing to one side of this a drop of calcium chloride solution, and on the other side a drop of Epsom salt solution. The three drops are joined to one another by narrow paths and evaporated. During the diffusion of the liquids which takes place, calcium sulphate is formed and appears in crystals of both gypsum and anhydrite along with the crystals of the chlorides. When a little water is added to a group of anhydrite crystals they are dissolved to recrystallize as gypsum. By properly regulating the amount of water added, *Knaüel* of gypsum may be formed with a corroded core of anhydrite. Although anhydrite has been frequently produced artificially, none of the methods heretofore used have simulated its production in nature from the evaporation of sea water.

Artificial Crystals of Zinc Oxide.—Ries[4] has examined artificial crystals of zinc oxide from the New Jersey Zinc Works and found them to possess the combinations (110), (225); (110), (112); and (110), (124): the form (124) being new. The crystals examined were colorless, transparent, holohedral, and devoid of basal cleavage.

Artificial Copper Crystals in Aventurine Glass.—Washington[5] has made a microscopical study of the aventurine glass from the famous Murano near Venice. The spangles of copper appear in large and small phenocrysts and in microlites. The large phenocrysts are .05–.12 mm. in diameter, of tabular habit, and not over .002 mm. thick They are generally hexagonal in outline, but some are equilateral triangles with the angles somewhat truncated. Distinct skeleton forms appear among the commoner individuals with plane faces. These crystals are all doubtless octahedra flattened parallel to an octahedral face, a habit which Dana has shown to be common in the case of copper crystals. Some individuals exhibited the distorted combination of cube and octahedron, while others were cyclic twins parallel to an octahedral face and either vierlings or fünflings, the latter producing a closed form.

New Minerals, *Neptunite and Epididymite.*—Flink[6] describes in detail two new minerals associated with ægerine from Greenland. The exact locality is not certainly known, but it is thought to be near

[4] Am. Jour. Sci., xlviii, p. 256, Sept., 1894.
[5] Am. Jour. Sci., xlviii, pp. 411–418, Nov., 1894.
[6] Zeitsch. f. Kryst., xxiii, pp. 344–367, 1894.

Narsisik. *Neptunite* is a black titano-silicate of iron, manganese, soda, and potash, which is found on the surface and in fissures in ægerine crystals, in crystals varying from microscopic dimensions to five centimeters. These crystals, which are monoclinic, exhibit the following forms : (100), (010), (001), (110), ($\bar{3}$01). ($\bar{2}$01), (111), (221), ($\bar{5}$12) and ($\bar{1}$11) ; the forms (001), (110), and the pyramid ($\bar{5}$12) predominating. The axial ratio is $a:b:c:=1.31639:1$; 0.8075 and $\beta=64° \; 22'$. Twinning is very rare with the base the twinning plane. Cleavage is distinct parallel to the prism, the cracks meeting at 80° in sections normal to $\acute{c}$. The specific gravity is 3.234 and the hardness 5–6. The plane of the optical axes is normal to the plane of symmetry and the acute bisectrix makes 18° with the vertical axis in the obtuse angle β. The absorption is $\mathfrak{c}$ deep red brown, $\mathfrak{b}$ yellow red, and $\mathfrak{a}$ bright red, with $\mathfrak{c}>\mathfrak{b}>\mathfrak{a}$. Written empirically the formula of the mineral is $(\frac{8}{9}Fe+\frac{1}{9}Mn)\ (\frac{3}{4}Na^2+\frac{1}{4}K_2)Si_4\ Ti\ O_{12}$. The interfacial angles never vary more than 10° from the corresponding angles of titanite, which leads Flink to think that neptunite and titanite are isomorphous.

Epididymite is dimorphous with the eudidymite of Brögger, the empirical formula of both minerals being $H\ Na\ Be\ Si_3O_8$. Epididymite is orthorhombic in symmetry, whereas eudidymite is monoclinic. The axial ratio of epididymite is $a:b:c=1.7367:1:0.9274$. The forms observed were (100), (010), (001), (110), (310), (210), (201), (403), (401), (101), (304), (203), and (221). The crystals are columnar parallel to $\bar{b}$, and the cleavage is perfect parallel to the base and less perfect parallel to the macro-pinacoid. $H=6$. $G=2.548$. The mineral is colorless. The plane of the optical axes is the base with $\breve{a}$ coincident with $\mathfrak{a}$ the acute bisectrix. The optical angle calculated from measurements of the indices of refraction is $2V_a=31° \; 4'$. The relation between epididymite and eudidymite would seem to be somewhat similar to that existing between the monoclinic and triclinic feldspars of the same composition.

Other minerals described from the locality are Xatapleite (heretofore found only at Langesund), ægerine, Arfedsonite, quartz, orthoclase, albite, eudialite, zircon, epidote, Zinnwaldite, microlite, and elpidite.

Crossite. Palache[7] has examined the "glaucophane" of some rocks from the Coast Ranges and finds it to differ so much from the known occurrences of glaucophane, that he proposes to call it crossite. The occurrence specially studied is in a boulder from the west slope of the Contra Costa Hills near Berkeley, Cal. Crystals of the mineral show

[7] Bull. Dept. Geol. Univ. of California, i; pp. 181–191, pl. 11, 1894.

the prism and clinal pinacoid, the prism angle being 126° 6′. The axis of greatest elasticity $\mathfrak{a}$ makes an angle of 11°–13° with $\dot{c}$, probably in the obtuse angle. The pleochroism is very strong with $\mathfrak{a}$ sky blue to dark blue, $\mathfrak{b}$ reddish to purplish violet, and $\mathfrak{c}$ yellowish-brown to greenish-yellow. The absorption formula is $\mathfrak{a} \overline{\overline{>}} \mathfrak{b} > \mathfrak{c}$. The strea is pale blue. G=3.126–3.16. Below are quoted the analyses of glaucophane (I), Riebeckite (II), and the Berkeley amphibole (III) for comparison:

	SiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	MgO	CaO	Na_2O	K_2O	Total
I.	55.64	15.11	3.08	6.85	.56	7.80	2.40	9.34	——	100.78
II.	50.01	——	28.30	9.87	.63	.34	1.32	8.79	.72	99.98
III.	55.02	4.75	10.91	9.45	trace	9.30	2.38	7.62	.27	99.70

Optically the mineral is almost identical with the amphibole described by Cross from Custer Co., Colorado, and it is closely related to Riebeckite. Chemically it is intermediate between Riebeckite and glaucophane.

Willyamite. Pittman[8] gives the name Willyamite to a sulphantimonide of cobalt and nickel from the Broken Hill mining district of New South Wales, having the formula (NiCo) S (Co Ni) Sb, cobalt and nickel being present in nearly equal amounts.

Kylindrite. Frenzel[9] describes a new mineral from Mina Santa Cruz at Poopó, Bolivia, which is notable as well for its unusual chemical composition as for its crystal form. Analysis furnished the following results:

Pb	Ag	Fe	Sb	Sn	S	Total
35.41	0.62	3.00	8.73	26.37	24.50	98.63

which correspond to the formula $Pb_6Sb_2Sn_2S_2$ or $6PbS, Sb_2S_3\ 6SnS_2$, the silver and iron replacing the lead. The mineral receives its name from the remarkable cylindrical rods in which it appears. On grinding these in the mortar they separate into concentric cylindrical shells. A few minute needles which were found in a cavity show the symmetry of the mineral to be orthorhombic. The lustre is metallic, the color dark leaden, and the streak black. H=2.5 and G=5.42. The mineral is soluble in hot hydrochloric and nitric acids, and melts in the closed tube with the separation of sulphur.

WM. H. HOBBS.

[8] Rec. Geol. Surv., New South Wales, iv, pt. i; pp. 21–22, 1894.

[9] Neues Jahrbuch f. Mineralogie, etc., 1893, II, pp. 125–128.

PETROGRAPHY.[1]

Geology of Angel Island, San Francisco Bay.—Angel Island in San Francisco Bay, Cal., consists essentially of a syncline of sandstone interbedded with an intrusive sheet of fourchite and cut by a serpentine dyke and a second mass of fourchite. A radiolarian chert is associated with the sandstone. The most interesting feature connected with the rocks is the discovery by Ransome[2] that both the fourchite and the serpentine have effected metamorphic changes in the sandstone and in the chert, and that in all cases the resulting product is the same, viz., a glaucophane schist. The serpentine and the fourchite are thus true eruptive rocks, neither being, as supposed by Becker, a metamorphosed sediment. The glaucophane schists are true contact rocks, and are not the result of a general oregional metamorphism of pre-existing rocks. Not only do they occur as contact facies of the sandstones and cherts, but the former rock often contains pebbles of schists, in their essential features similar to the contact schists· The sandstone is made up of quartz, plagioclase and fragments of various rocks. The fourchite consists almost entirely of nearly colorless augite in rounded or irregular grains, and a small quantity of an interstitial substance composed of smaller granules of augite and a fine grained neatrix, which under high powers resolves itself into small, stout colorless crystals imbedded in a yellowish-green substance that is nearly isotropic. The crystals are thought to be zoisite, which may be an alteration product of plagioclase, although the author thinks this origin not probable. Often the augite is changed peripherally into glaucophane, which either replaces the pyroxenes, fills cracks in them, or occurs in the spaces between adjacent grains. A few of the specimens examined possess a glassy groundmass and others are porphyritic. Brecciated and spheroidal facies were also observed. The schist produced by the alteration of the sandstones and cherts is sometimes composed of aggregates of glaucophane in a matrix of colorless albite. Brown mica, garnets and sphene are also present to some extent in the rock. Other varieties of the schist are essentially aggregates of quartz and glaucophane. Occasionally the glaucophane is in falrly well defined crystals, but usually it is in sheaf-like bundles of fine needles. The altered cherts now consist of spherules of cryptocrystalline silica

[1] Edited by Dr. W. S. Bayley, Colby University, Waterville, Maine.

[2] Bull. Dept. Geol. Univ. of Cal., Vol. 1, p. 193.

or grains of recrystallized quartz and microlites and bundles of nearly colorless augite. The serpentine on the island is nodular as the result of shearing. It was derived in all probability from a rock made up almost exclusively of diallage. It contains granules of chromite. This serpentine has effected the same alterations in the chert and sandstone through which it cuts, as has the fourchite. Some peculiar inclusions of a dark rock in the serpentine are supposed to be the remnants of a dyke that formerly occupied the fissure, which the serpentine subsequently filled. These fragments now consist of a holocrystalline aggregate of augite and albite, of which the first mineral is sometimes altered to green and brown hornblende. Analyses of the fourchite (I) and of a fresh nodule of serpentine (II) follow:

	SiO_2	Al_2O_3	Fe_2O_3	FeO	CaO	MgO	K_2O	Na_2O	P_2O_5	Loss	Total
I.	46.98	17.07	1.85	7.02	12.15	8.29	.53	2.54	.09	4.86	=101.38
II.	42.06	2.72	2.88			39.53	not estimated			12.04	= 99.23

A New Rock-Volcanite.—In an abstract of a paper to appear in a German periodical, Hobbs[3] gives an account of an anorthoclase-augite rock which he calls volcanite. It occurs as bombs projected from Volcano in 1888–89. Phenocrysts of anorthoclase, andesine, an acmitic augite and olivine are imbedded in a groundmass containing two generations of the first named of these minerals in a glassy base. The augite phenocrysts in many instances have been resorbed by the rock's magma and have thus given rise to pseudomorphs of colorless pyroxene, magnetite, and plagioclase. The structure of the rock is trachytic. Its chemical composition corresponds with that of the dacites, while its mineralogical composition is that of an augite pantellerite. Analyses of the anorthoclase (II) and of the rock mass (I) follow:

	SiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	CaO	MgO	Na_2O	K_2O	H_2O	P_2O_5	Total
I.	66.99	17.56	1.41	3.39	tr	4.25	.93	3.35	.34	1.53	tr	= 99.75
II.	60.01	20.12	2.82			5.15	.23	6.43	3.67	.77		= 99.20

Acmite Trachytes from Montana.—Among the eruptive rocks occurring as dykes, sheets and laccolitic masses in the Cretaceous of the Crazy Mts. are acmite trachytes and eleolite syenites. The former, according to Wolff,[4] is present in small sheets and dykes and in

[3] Bull. Geol. Soc. Amer., Vol. 5, p. 598.

[4] Bull. Mus. Comp. Zool., xvi, p. 227.

apophyses from laccolitic masses. It is a rock made up of phenocrysts of anorthoclase, sodalite and augite in a groundmass of lath-shaped feldspars and acicular aegirines and acmites imbedded in a colorless interstitial matter, composed in all probability of nepheline and analcite. The augite phenocrysts are provided with an outer zone of aegerine. Needles of this mineral are included in all the colorless constituents. The eleolite syenite is from the laccolites. It is panidiomorphic, with fresh onorthoclase phenocrysts in a fine grained mass of feldspar, augite, aegerine, acmite, the angular spaces between which are occupied by nepheline. Analyses of the syenite and of one variety of the trachyte gave:

SiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	CaO	MgO	Na_2O	K_2O	TiO_2	P_2O_5	Ign.	Loss	Total
59.66	16.97	3.18	1.15	.19	2.32	.80	8.38	4.17	tr	.14	2.53	.07	99.56
62.17	18.58	2.15	1.05	tr	1.57	.73	7.56	3.88	tr	.11	1.63	.07	99.50

Petrographical Notes.—In a glassy rock from near Harrismith, in the Orange Free States, Molengraff[5] finds small crystals of twinned cordierite, little octahedra of magnetite and skeleton crystals of augite. The cordierite is slightly pleochroic. Its crystals are well defined and possess all the peculiarities of the mineral. An analysis of the rock shows:

SiO_2	TiO_2	Al_2O_3	Fe_2O_3 FeO	MgO	CaO	K_2O	Na_2O	Loss	Total
64.54	.79	19.16	7.23	3.39	2.47	.57	1.13	2.25	=101.53

The large percentage of SiO_2 present as compared with the small percentages of the alkalies suggests to the author that the rock is an abnormal type. After a critical discussion of the literature of cordierite as a rock component, the conclusion is reached that, in all probability, the specimens studied represent foreign inclusions fused in a basic rock.

A very brief account of the lavas and ashes of the old volcano Rhobell Fawr near Dolgelley in Wales, is given us by Cole.[6] The greater portion of the products are ashes containing hornblende and augite. The lavas are augite, aphanites and basaltic and andesitic andesites.

[5] Neues Jarb. f. Min. etc., 1894, I, p. 79.

[6] Geol. Magazine, x, 1893, p. 337.

Rutley[7] gives a few illustrations in proof of his statement that the production of spherulites is sometimes a devitrification process subsequent in point of time to the development of perlitic cracks in the volcanic rocks in which they occur.

In a recent number of Science Blake[8] suggests the notion that many of the quartz veins, 'reefs' and boss-like masses in ancient rocks are the result of deposition from old thermal springs.

The rock of Saint Sardoux, Puy-de-Dame, France, is composed[9] of ilmenite and soda-augite in a groundmass consisting largely of nepheline crystals cemented by a matrix of feldspar and glass. Sometimes the augite and nepheline are intergrown like the constituents of a pegmatite and at other times they form an ophitic aggregate, with the nepheline the older component. The rock penetrates the peperites of the region in the form of dykes and veins.

New Books.—Granites and Greenstones[10] is the title of a new series of tables for the determination of rocks and their essential components. The author, Mr. Rutley, divides rocks into Volcanic rocks, Dykes and Sills and Plutonic masses, and then subdivides each group into four series as follows: Ultra-basic with SiO_2=39–45 per cent; basic, with silica 45–55 per cent, intermediate, with SiO_2=55–66 per cent; and acid, with silica over 66 per cent. The ultra-basic series is divided into the non-feldspathic and the potentially feldspathic, including nepheline and leucite non-feldspathic rocks. The basic rocks are all plagioclastic. They include a nephelinic or leucitic and a non-nephelinic group. In the dyke and sill division of this series are included the diabases. In the intermediate series we find again two groups—the orthoclastic and the plagioclastic, and in each of these nepheline and non-nepheline sub-groups. The acid series includes a division whose feldspars are plagioclase or anorthoclase, and one in which the feldspar is orthoclase. Definitions and notes are abundant and are so given as to really explain the tables. The elvans are described as the apophyses of deep seated granitic masses. They include micro-granites, aplites, quartz-porphyries and greisens. The mineralogy tables contain no startling novelties. They are good and the book itself is well worth study. It will serve as a useful companion to the student.

[7] Quart. Jour. Geol. Soc., Feb. 1894, p. 10.

[8] Science, Vol. xxiii, 1894, p. 141.

[9] Bull. Soc. Franc. d. Min. xvii, p. 43.

[10] Granites and Greenstones, a series of Tables and Notes for Students of Petrology. By Frank Rutley. London, Thos. Murby, 1894, pp. 48.

In an article of 52 pages on the optical recognition and economic importance of the common minerals found in building stones, Luquer[11] mentions the principal microscopic characteristics of the most important minerals with sufficient fullness to enable the technical student to determine them in the thin section. He also notes the effect of presence of each upon the value of the various building stones in which they occur. He, moreover, describes the usual associates of each different mineral, and so incidentally gives the composition of the principal rocks used in constructions. The article in pamphlet form is simple and useful.

[11] School of Mines Quart. xv, p. 285-336.

GEOLOGY.

Meunier on Meteorites.—The collection of meteorites in the Natural History Museum of Paris is unexcelled to-day in respect to variety and quantity of material amassed. To this series of natural meteorites has been added the products of experimental syntheses resulting from attempts to solve the problem of the origin of meteorites. Further facility in the study of this extramundane material is afforded by bringing together the meteoric minerals and types of analogous earth minerals for the purpose of comparison. It has been thought possible by M. Stanislas Meunier to arrive at some definite conclusion as to the origin and possibly the past history of meteorites by a close study of their composition and a comparison of their mineral constituents with similar minerals occurring in our own earth formations. Such a study, embracing as it does both geological and astronomical facts, he calls comparative geology.

M. Meunier takes for a starting-point the meteorites of Chili, which, for convenience, are classified under special types. Each type is described in detail, its particular lithological characters discussed, and their significance given. In the course of the examination M. Meunier finds true breccias, metamorphic rocks and volcanic rocks so similar to terrestrial eruptions that the closest attention is necessary to detect the difference. The conclusion from these facts is that the original source of these meteors has been the theatre of geological phenomena comparable with those occurring on the earth.

M. Meunier does not hold with the theory that meteors and shooting-stars have a common origin. The chief objections to the theory are: (1) Shooting-stars are never accompanied by noise; meteors always are. (2) Shooting-stars are periodical in appearance; meteors are irregular. He is of the opinion that meteors are fragments of a single star which was constructed on the same general plan as our planet, and notes that it is possible that the fragmentary stage is the last phase of a true sidereal evolution. (*Actes Soc. Scien. du Chili, Tome III.*)

The Origin of Bitumens.—In a recent number of the *American Journal of Science*, S. F. Peckham gives a short account of how he was led to adopt Newberry's "distillation" theory to account for the origin of bitumens. The heat required for distillation results from metamorphic action. In regard to the oils of eastern Ohio and western Pennsyl-

vania, the agent for their production was found in the gradual dying out of the heated area which involved the Appalachian system. Beginning at the Palisades and following a northwesterly line, Mr. Peckham notes the following facts in proof of his theory: Through eastern Pennsylvania the coal is metaphosed into anthracite. At St. Mary's, on the summit of the Alleghanies, the coal is semi-anthracite. In the most easterly county of Pennsylvania in which petroleum is obtained, McKean, the petroleum occurs at a depth of two thousand feet, under a pressure estimated at four thousand pounds to the square inch, and filled with paraffine, just as it ought to be if produced by metamorphism. Further west the petroleum becomes lighter. The products of distillation are present in proper sequence along the entire line from Point Gaspè to Lookout Mountain, and the porous sand-bars and pebbly ripples formed by the currents of the primeval ocean are not filled with the oil, because they afford a receptacle adequate to receive and store the vast accumulations of distillate. (*Amer. Jour. Sci.*, Dec., 1894.)

Changes in Ore Deposits.—The chemical and physical changes that take place in ore deposits exposed to surface influences has been made the subject of study by Mr. R. A. F. Penrose, Jr., and the results of his investigations embodied in the following summary:

The process of alteration is primarily one of oxidation, and generally of hydration, and both of these actions may go on alone, but generally both have their effect upon the same material. The action of surface influences is in rare cases one of reduction. The process of alteration frequently causes leaching of certain ingredients of the ore deposit. A worthless material may be made valuable by the introduction of a new constituent, as in the replacement of a carbonate of lime by a phosphate of lime. Deposits are sometimes concentrated by capillary action in soils.

The physical effect of superficial alteration is to make the deposit more open and porous, and to cause it to shrink. If, however, hydration is active, expansion may be caused.

The depth of alteration varies from a fraction of a foot to 1500 feet, and possibly more.

The accumulation of soluble saline materials on the surface has an important effect in converting certain materials in underlying ore deposits to chlorides, etc. This explains the abundance of haloid compounds in ore deposits of the arid regions of the western part of North America, and in certain parts of Chili and Peru. (*Jour. Geol.*, Vol. II, 1894.)

Dean on Coprolites.—In the description of a new Cladodont shark, *C. newberryi*, from the Ohio Waverly, Mr. Bashford Dean refers to a coprolite found with the specimen, as follows:

"It (the coprolite) is especially interesting, since it furnishes a cast of the intestinal wall, and gives definite evidence as to the presence of a spiral valve. This structure accordingly maintained in the generalized Cladodont, and that the intestinal septa were here low and numerous is most significant phylogenetically. Its condition in this form, as the nearest known ancestor of Selachians, would, moreover, give an additional reason for emphasizing the most ancient origin of Dipnoan, Teleostome, and even Chimæroid."

This discovery of Dr. Dean throws a light upon certain screw-like fossils described under the names Spiraxis, Spirangium, etc. Newberry's descriptions and figures of *Spiraxis major* and *S. randallii*, from the Chemung sandstone, are identical with the coprolite figured by Dr. Dean from the intestine of the shark. The inference, then, is that many of these screw-like forms from geological horizons, in which sharks are numerous, and which have been referred by different investigators to Algæ, are in reality coprolites. (*Trans. N. Y. Acad. Sci.*, Vol. XIII, 1894.)

New Molluscan Forms from the Dakota Formation.—So little is known of the fauna of the Dakota formation that great interest is attached to the discovery by Dr. Hicks of some invertebrate remains in Jefferson County, Nebraska. The Dakota strata in this locality consist of ferruginous limestone, the fossiliferous layers being impure limonite. The fossils are all either vegetal or molluscan, and are in the condition of natural casts, molds or imprints. The mollusca were referred for identification to Dr. Charles A. White, who describes and figures them in the Proceedings of the National Museum. The collection comprises five new species and two doubtful ones, all indicating unmistakably, in the author's opinion, a purely fresh-water fauna.

In his concluding remarks, Dr. White refers to the unusual interest attached to these new forms by reason of the following facts:

"It is one of only three collections of invertebrate remains from the Dakota formation. It indicates, more distinctly than any previously discovered facts have done, the nonmarine character of that formation. It embraces four genera which have never before been recognized in collections from its strata. Lastly, although this formation lies at the base of the Upper Cretaceous series, a majority of the species which this collection contains belong to genera representatives

of which are among the characteristic members of the molluscan fauna now living in the waters of the Mississippi drainage system. (*Proceeds. U. S. Natl. Mus.*, Vol. XVII, 1894.)

Glacial Lakes in Western New York.—This subject is treated in two papers which describe briefly the glacial lacustrine history of Western New York, introductory to fuller treatment hereafter. The author shows, with the aid of specially prepared maps, how the remarkable valleys of the "finger lakes" terminate abruptly at their southern ends in the high land which forms the divide between the St. Lawrence and the Susquehanna—Ohio waters. The deep preglacial valleys, cut to some unknown depth through the divide, have been partly filled with frontal moraine drift-making cols, which were the waste-weirs for the glacial waters.

As the ice-sheet slowly retreated northward, it was a barrier to the waters which were poured in the south ends of these deep valleys and forced to overflow into the Susquehanna. In all the valleys a well-marked abandoned stream channel is found south of the col, while north of the col are found the delta deposits of the streams which emptied into the glacial lakes at their maximum and later levels.

The author described with some detail several of those local glacial lakes, among which were the Watkins (glacial Seneca) Lake, which at its maximum was about thirty miles long, some four to eight miles wide and one thousand feet deep. The Ithaca (glacial Cayuga) was even larger and deeper than the Watkins Lake. The deltas and shore inscriptions of all the glacial lakes are well marked, and in this lies proof of the power of ice to act as barrier to deep water.

Glacial lakes also occupied valleys in which to-day there are no lakes, but free northward-flowing streams, as the Tonawanda, Canaseraga, Genesee, Onondaga and others. Professor Fairchild named eighteen of the local glacial lakes from Attica on the west to Tully Valley on the east.

As the ice-lobe damming each of the several glacial lakes melted, the waters were lowered into the level of the great water body which buried all of Western New York north of the divide and most of the area of the Great Lakes. At first this water had its outlet at Chicago, and has been named by Mr. Spencer, Lake Warren. But when the ice by its retreat finally uncovered the Seneca Valley, the outlet of the Watkins Lake at Horseheads became, owing to the depression of the "Finger" lakes region, the outlet of the Continental lake, and this remained the outlet until the ice, by its further retreat, uncovered the

Mohawk Valley and differentiated the waters, the lake then covering the Ontario depression, being known as Lake Iroquois. For the lake having its outlet at Horseheads, and lying both in geographical horizon and in time between lakes Warren and Iroquois, Professor Fairchild proposed the name Lake Newberry. —H. L. Fairchild.

Geological News, General.—An excellent geological map of Alabama has just been issued by the Geological Survey of that State. For the exact determination of the limits of the geological formations as shown in the map, its chief responsibility and credit are as follows: Formations of the coastal plain, Smith, Langdon and Johnson; coal measures, McCalley, Squire and Gibson; other Paleozoic formations, McCalley, Gibson and Hayes; crystalline rocks, Smith, Phillips and McCalley. The colors chosen are distinct, so that the different horizons are well defined. An explanatory chart accompanies the text.

According to F. Leslie Ransome, Angel Island, in San Francisco Bay, affords an example of a pronounced contact metamorphism effected by the rock of which serpentine is a derivative, and by the fourchite, upon cherts and sandstones through which they have forced their way. The resulting rocks consist almost wholly of holocrystalline schists, which present no essential differences when derived from sandstone from those formed by the metamorphism of the chert; also, the schist produced by contact metamorphism alongside the serpentine has no distinct feature differentiating it from that adjacent to the fourchite. This leads to the generalization that the attempt to assign all of the glaucophene schists of the coast ranges to a general regional metamorphism must be abandoned. (*Bull. Dept. Geol. Cal. University.*, Vol. I, 1894.)

Archean.—The so-called Lower Laurentian rocks, near St. John, N. B., are found by W. D. Matthew to consist in large part of intrusives of two types, Granite-diorite and Olivine-gabbaro. The age of the first of these is later than the Upper Laurentian limestone, and may be Devonian, but is probably pre-Cambrian. The age of the gabbro is not given. (*Trans. N. Y. Acad. Sci.*, Vol. XIII, 1894.)

Paleozoic.—The fossils from the Trenton limestones of New York, referred by Prof. Hall to the Graptolitidæ under the names of *Buthograptus laxus* and *Oldhamia fruticosa*, are shown by Prof. Whitfield to be true marine Algæ of the articulate type. The form of the Buthograptus when living was probably plumose, with a cylindrical

axis, from which a series of pinnules arose on two opposite sides, not quite opposite to each other at their origin, but slightly alternating. These pinnules were probably cylindrical, somewhat club-shaped, and attached to the axis by the knob-like inner end. Since the name *Buthograptus* is misleading, the author suggests *Bythocladus* as more appropriate. Of the so-called Oldhamia, Prof. Whitfield has found three forms which he describes and figures in the *Bull. Amer. Mus. Nat. Hist.*, Vol. VI, 1894.

A new fossil fish, *Psammosteus taylorii*, from the Upper Old Red Sandstone of Morayshire, Scotland, is reported by Dr. Traquair. The new species is based on detached plates thick and smooth internally, and as to contour are gently hollowed in boat-like fashion. The microscopic structure of the remains suggests that they were Selachian in their nature. (*Ann. Scottish Nat. Hist.*, 1894.)

Bulletin No. 4 of the Illinois State Museum of Natural History contains descriptions by Miller and Gurley of thirteen new Crinoids from the Upper Devonian and Niagara of Indiana, Kentucky and Illinois. Three plates accompany the descriptions.

Mr. E. O. Hovey regards the Lower Magnesian and Lower Carboniferous cherts of southern Missouri due to chemical precipitation at the time of the deposition of the strata in which they occur or before their consolidation. (*Amer. Jour. Sci.*, 1894.)

Mesozoic.—The study of new material by Prof. Seeley confirms Huxley's conclusions concerning *Euskelesaurus brownii*, a fossil Dinosaurian from South Africa. The jaw is formed on the type of Megalosaurus, but the pubis resembles that of Massospondylus. Prof. Seeley places it in the Saurischia in near association with the latter genus and Zanclodon, though with a near approximation to Megalosaurus. The evidences for these conclusions are given in the account to the several bones. (*Amer. Mag. Nat. Hist.*, Nov., 1894.)

M. H. E. Sauvage calls attention to some reptiles found in the upper part of the Jurassic beds of Boulonnais. A list of the species determined by the author comprises four Ichthyopteryians, eleven Sauropterygians, one Pterodactyle, four Dinosaurians, eight Crocodiles and seven Chelonians. (*Revue Scientifique*, Dec., 1894.)

According to Capt. H. G. Lyons, the Nubian sandstone of Egypt and Nubia is of Cretaceous age, and is probably an estuarine deposit. In the Lybian Desert this sandstone forms an immense table-land, weathered into flat-topped masses and truncated pyramids, witnesses of the amount of erosion that has taken place. Upper Cretaceous rocks

overlie the sandstone near Esna, and are exposed over a large area forming the floors of the oases of Kharga, Dakhla and Tarafra. (*Quar. Jour. Geol. Soc.*, Nov., 1894.)

Cenozoic.—Mr. Barbour presents some additional notes on the new fossil, Dæmonelix, from the Pine Ridge table-lands in Nebraska. Further examination of the locality in which the fossil occurs shows that the whole deposit is undoubtedly aqueous in origin, and the author gives his reasons for believing the fossils to be contemporaneous with the sediment. A singular fact revealed by the microscope is that every section, no matter from what specimen or from what portion of each individual specimen the section is made, shows perfectly definite and unmistakable plant-structure. (*Univ. Studies*, Vol. II, 1894.)

A fine specimen of *Cervus* (*Eurycerus*) *hibernina* Owen belonging to Dr. Krantz Museum affords Dr. Pohlig an opportunity for studying the relation of this species to others of the same group. He shows that the deer (*Cervus dama*), and not the elk (*C. alces*), is the nearest ally of Eurycerus, and that these two species are closely united by transitional forms in both types. Dr. Pohlig bases these relations between the different species of the Cervidæ upon the development of the antlers. (*Bull. Soc. Belge de Geol., Tome VIII*, 1894.)

Numerous small displacements produced since the glacial period in the rocks about St. John, N. B., are noticed by G. F. Matthew. The faults vary from one-quarter of an inch to five inches, and in almost every case the downthrow was on the north side, and the leade of the fault was to the southwest. (*Amer. Jour. Sci.*, Dec., 1894.)

BOTANY.[1]

The Systematic Botany of North America.—Under this title a work of great importance to science is now in preparation for early publication. Following the suggestion of Rabenhorst's "Kryptogamen Flora," and Engler and Prantl's "Natürliche Pflanzenfamilien," the originators of the project have sought to bring to their aid as many as possible of the working botanists of North America. Accordingly we find the names of Professor G. F. Atkinson, of Cornell; Professor N. L. Britton, of Columbia; President J. M. Coulter, of Lake Forest; Chief Botanist F. V. Coville, of the National Herbarium; Professor E. L. Greene, of California; Professor B. D. Halsted, of Rutgers, and Professor L. M. Underwood, of De Pauw, upon the board of editors, with such as the following in the list of those who have assured the editors of their coöperation: Professor T. C. Porter, of Lafayette; Professor C. R. Barnes, of Wisconsin; Director Wm. Trelease, of the Missouri Botanical Garden; Professor L. H. Bailey, of Cornell; Professor C. S. Sargent, of Harvard; Professor T. J. Burrill, of Illinois, and many others equally well known.

In the mode of publication the German plan will be followed also, the work to appear in parts of about one hundred pages each, published at intervals, five of these parts usually constituting a volume. The sequence will be that of Engler and Prantl's "Natürliche Pflanzenfamilien," and will include all plants from the Protophyta to the Compositæ. It is estimated that it will require about seventeen volumes for the whole work, or about eighty-five parts, and that it will take fifteen years to complete it. According to the present plan, Volume I will contain the *Myxomycetes*, *Schizomycetes*, *Cyanophyceæ* and *Diatomaceæ;* Volume II, the algæ; Volumes III to VIII, the fungi; (Vol. IV, the lichens); Volume IX, the *Bryophyta*, *Pteridophyta* and *Gymnospermæ;* Volumes X and XI, the Monocotyledons; Volumes XII to XVII, the Dicotyledons.

It is announced that the following parts are to appear during 1895: *Pyrenomycetes* (two parts), by J. B. Ellis and B. M. Everhart; *Hepaticæ*, by L. M. Underwood; *Typhaceæ*, *Sparganiaceæ*, *Naiadaceæ*, *Juncaginaceæ*, *Alismaceæ* and *Hydrocharitaceæ*, by Thomas Morong; *Cyperaceæ* (two parts), by N. L. Britton and L. H. Bailey.

The parts may be obtained as issued of Professor N. L. Britton, of Columbia College, New York, the chairman of the board of editors.

CHARLES E. BESSEY.

[1] Edited by Prof. C. E. Bessey, University of Nebraska, Lincoln, Nebraska.

Botanical News.—Botanists everywhere will be glad to learn that the veteran collector, A. H. Curtiss, of Jacksonville, Florida, has resumed the collection and distribution of herbarium specimens. All who have seen the fine specimens which Mr. Curtiss prepared in his sets of North American plants distributed ten or more years ago need not be told of their superior quality. He now offers in this "Second Distribution of Plants of the Southern United States" two "series" of two hundred species each, at sixteen dollars per series. It is to be hoped that this distribution will be given the encouragement it deserves.

The experiment of publishing monthly the cards for the card-index to the Bibliography of American Botany has been most successful so far as the work itself is concerned. The printing has been excellent, and a very good quality of card has been used. We trust that botanists who have not already done so will enter their subscriptions soon for this most useful help in the botanical library. The annual subscription is five dollars, and the cards are supplied by the Cambridge Botanical Supply Company, Cambridge, Mass.

Among the excellent text-books of botany which have recently appeared in Germany, two deserve especial mention, viz.: Dr. K. Giesenhagen's *Lehrbuch der Botanik,* a pretty volume of 335 octavo pages, from the publishing house of E. Wolf, of Munich, and Dr. K. Schumann's *Lehrbuch der Systematischen Botanik,* of 705 octavo pages, published by F. Enke, of Stuttgart. Both are freely illustrated with good engravings. They will be helpful to those engaged in teaching botany in colleges and universities.

Oels's *Experimental Plant Physiology,* as translated by D. T. MacDougal, of the University of Minnesota, is a most useful little book. A somewhat extended trial with students in physiological botany shows it to be well adapted for laboratory use.

We would like to commend to the botanists of this country, especially to those who are engaged in teaching in the better class of colleges and universities, that most excellent journal, *Garden and Forest,* edited by Professor Charles S. Sargent, of Harvard University. Coming as it does every week, it brings fresh matter to the reader at frequent intervals, and there is not a number in the whole year which does not contain much botanical matter.

Our three strictly botanical journals, *The Bulletin of the Torrey Botanical Club* (now entering its twenty-second volume), *The Botanical Gazette* (entering its twentieth year), and *Erythea* (in its third year), have continued their steady ways the past year, in spite of

panics and general business depression. They are journals of which American science has no cause to be ashamed. The two older journals include the record of a period of remarkable activity in American botany, and it is fair to say that from them has largely come the impulse to this activity. We doubt not that a score of years hence we may say the same for the much younger journal upon the Pacific coast.

Professor A. S. Hitchcock brought out two handy little books during the past year, viz., *A Key to the Spring Flora of Manhattan* (Kansas), and *A Key to the Genera of Manhattan Plants Based on Fruit Characters.* They are full of suggestions to teachers, and must be very helpful to students of botany in Eastern Kansas. The sequence of families is that of Engler and Prantl.

Professor L. H. Bailey brought out in the August bulletin of the Cornell University Agricultural Experimental Station another of his numerous contributions to botany. This one is devoted to *The Cultivated Poplars,* and with the illustrations and descriptions of the leaves, twigs and buds, must prove useful to those who wish to distinguish the cultivated species of this interesting genus.

From the Bulletin of the Michigan Fish Commission (No. 2) we have "The Plants of Lake St. Clair," by A. J. Pieters, containing eleven pages of text and a map. Lists of aquatic plants are given, and these are accompanied by a discussion of their distribution at different depths and under varying conditions. —C. E. B.

ZOOLOGY.

The Influence of changed Environment on Mollusca.—The experiments made by Professor Semper with specimens of snails in order to ascertain the causes of dwarfing have recently been repeated by M. H. de Varigny who arrives at somewhat different conclusions from those of Prof. Semper. The experiments consisted in isolating young individuals from the same mass of ova in vessels containing different amounts of water, but placed under the same conditions of food, temperature and light. It was found that the size of the individual varies with the volume of water, and Dr. Semper's conclusion is that there is present some substance, as yet unknown, was necessary to the growth of the snail. M. de Varigny observed that while the size does vary with the volume of water, the dimensions vary more with amount of water surface than with volume alone, and increase in size persists when the superfices was increased while the volume was diminished. M. de Varigny suggests that dwarfing is due to lack of room in which to move about. (Journ. del 'Anatomie et de la Physiologie, 1894.)

The genus Leptophidium.—In 1863 I established the genus Leptophidium for ophidiids having a slender form and regularly embricated scales. Having had occasion recently to refer to Hallowell's "Report upon the Reptilia of the North Pacific Exploring Expedition" (Proc. Acad. Nat. Sc. Phila., 1860) I found that he had used the same name previously for a genus of snakes. After endeavoring in vain to identify Dr. Hallowell's genus, I asked Dr. Stejneger and he informed me that he had also vainly attempted to identify the same snake and that no specimens answering to Hallowell's diagnosis were in the National Museum. Prof. Cope has not mentioned the name as that of a valid genus or as a synonym in his Catalogue of Genera of Snakes. (Bull. U. S. Nat. Mus., no. 32, 1887).

But, whatever, may be ascertained to be the value of Hallowell's genus, there is no doubt that *Leptophidium* cannot be retained as the name of the Ophidioid genus. *Lepophidium* (scale, and *Ophidium*) may be given as a substitute and to recall the regular squamation characteristic of the genus.

Lepophidium has proved to be one of great interest and to be represented by a number of species in moderately deep seas. In addition to (1) *L. profundorum* and (2) *L. brevibarbe*, the following were described

by Jordan and Bollman (1889) and Goode and Bean. (Proc. U. S. Nat. Mus., 1890, pp. 108–110).

3. Lepophidium prorates.
4. Lepophidium pardale, 29 fathoms.
5. Lepophidium microlepis, 76 fathoms.
6. Lepophidium stigmatistium, 112 fathoms.
7. Lepophidium emmelas, 306–362 fathoms.

It will be for the future to determine whether these species are characteristic of different horizons or whether they inhabit indifferently various depths.

THEO. GILL.

The Habitat of the Salamander Linguelapsus annulatus Cope.—A single specimen only of unknown habitat has hitherto represented this species in the U. S. National Museum. It is, therefore, of interest that we are able to describe a second specimen as identified by Dr. L. Stejneger from Hot Springs, Arkansas. The specimen is 165 mm. in total length with a comparatively long tail as compared with any of the Amblystomæ we have seen. The specimen is still in Dr. Stejneger's hands, so we cannot give an exact description of it, but we observed the following facts with regard to it as compared with the description of the type in your "Batrachia of North America." The general color was brown above, crossed by narrow bands of gray, and paler below, the first gray band was between the orbits, the second on the occiput, the third on the shoulders; between the shoulder and rump there were one or two less bands than in the type, those on the tail we did not count, two of the bands on the tail united on one side forming a loop.

The head seemed small and the body bulky compared with any other salamanders we have seen. The fore and hind limbs when appressed to the sides were separated by 3 and parts of 2 other costal interspaces as in the type. Taken at Hot Springs, Ark., Nov. 1, 1894.

—H. H. & C. S. BRIMLEY.

The White Headed Eagle in Northern Ohio.—The White Headed Eagle is a resident bird on the peninsula that bounds Sandusky Bay on the north. For more than fifty years there has been a nest on the farm now owned by Mrs. Lammers, about half a mile north of the Danbury Post-Office. The present one has stood only nine years but it was made from the material of another belonging to the same pair

of birds and removed by them to the tree it now occupies after the one which held their old nest had been blown down. Both birds rarely if ever leave their nest at the same time in the course of the whole year. While one goes to the bay for fish the other remains at the nest or at least in the same small piece of woods awaiting the return of her mate or sometimes starting out when she sees him coming. No wonder they feel some solicitude for the home where they have reared so many broods of young and where their abode has been winter and summer for so many years. Occasionally they are visited by a third whom we may suppose to be one of their grown up children returning after long absence to his parents for advice. At any rate he is so well received that he is apt to stay several months.

At this nest two new eaglets, or sometimes only one, are reared each year, but they wander far away from home before they are old enough to find mates and start a new family, for these are only one or two new nests within many miles around. There is another old one about three miles east of this, not far from Piccolo station; another between Port Clinton and Peachton, and one 26 or 27 years old on Kelly's Island. There is also one nest on Put-in-Bay, one on Middle Bass, on North Bass and on Sugar Island. So far as I can learn all the nests are believed by the people that live near them to have been occupied continuously by the same pair of birds for many years. At each nest one bird remains while the other goes in search of food. The pair on Kelly's Island commenced a new nest, near their old one, about two years ago, and have worked on it a number of times since, but have not yet used it. They are supposed to be getting ready to move, on account of the tree containing the old nest being dead. Most of the nests are about 50 feet from the ground and appear to be five or six feet high and four or five across. The birds raise only one brood a year, and rarely, if ever, more than two in a brood, but these two they usually succeed in bringing up, and as eagles are rarely killed in this region, many that are raised here must go elsewhere to live. Quite likely they go farther north, yet it would seem as if the American Eagle were disinclined to make a permanent home beyond the limits of the republic that has adopted it. Perhaps the freezing of the Canadian streams and lakes from which they draw their supply of fish in mild weather drives them south to the Great Lakes. At any rate there are many more eagles on the peninsula in winter than in summer. Two years ago more than fifty were seen at one time on the ice covering what

is called the west harbor, and about seventy-five on the east harbor, feeding on the fish offal thrown away by the fishermen. As the majority of these winter visitors lack the white on head and tail that characterizes the old birds it may be that they are birds that have not mated or built nests.

The eagles at all times of the year subsist on fish, eating but little else. They take them alive from the water and dead from the shore, and here as well as on the Atlantic coast they occasionally take them from the osprey. When an eagle captures a live fish it is sometimes pursued by another eagle which succeeds after a spirited struggle in getting it away. Among the farmers they are not considered beneficial nor very harmful, though they occasionally take tame ducks and, it is said, lambs. On Kelly's Island and Put-in-Bay they are less numerous than formerly, but on the peninsula the number is increasing.

—E. L. Moseley.

The Paludicolæ.—Dr. Shufeldt offers the following scheme to show the divisions of the suborder, Paludicolæ, of the United States:

Suborder.	Superfamilies.	Families.	Genera.
Paludicolae	Gruoidea	Gruidae,	Grus.
		Aramidae,	Aramus.
	Ralloidae	Rallidae	Rallus.
			Crex.
			Porzana.
			Ionornis.
			Gallinula.
			Fulica.

In regard to the connection of the Paludicolae with other avain groups, the author notes that the Jacanidae link this suborder with the Limicolae, through certain species in the Plover-Sandpiper line; Podica and Heliornis lead towards the Pygopodes; and such ancestral types as Chionis connect them with the Longipennes; by various links they are connected also with the Herodiones, through Rhinochetus and Eurypyga.

Professor Fürbringer believes that the Apteryges are far more closely related to the Rallidae than has been, heretofore, realized. If this be true, it forms a line toward the Struthious types—with all the Gallinae likewise only a little more remotely related. (Proceeds. Zool. Soc. London, March, 1894.)

Mexican Glires.—In studying the series of Mexican Rodents collected by Mr. E. W. Nelson, Dr. C. H. Merriam finds that a wood rat described by him sometime ago under the name *Neotoma alleni* represents a new genus for which he proposes the name Hodomys. This genus is characterized by having the crown of the last molar shaped like the letter S, and also by important cranial distinctions.

Associated with Hodomys, by reason of dental characters are Ptyssophorus, Tretomys (both fossil) Xenomys and Neotoma. These five genera form a group presenting, according to Dr. Merriam, nearly every important step in the evolution of the modern genus Neotoma from the Cricetine series, Ptyssophorus is the more primitive type; Tretomys and Hodomys seem to represent more advanced stages in the evolution of the group, while Xenomys and Neotoma are more specialized.

The five genera above enumerated are classed together by the author, as a subfamily, the Neotominae, and it seems to be an independent offshoot, as is also the Arvicolinae, from the half-tuberculate crowned Cricetinae.

Dr. Merriam redefines the genera Ptyssophorus and Tretomys, and characterizes the new genus Hodomys with reference to the more specialized genera Xenomys and Neotoma, and adds descriptions of all the known species. (Proceeds. Phila. Acad. Nat. Sci., Sept., 1894.)

Zoological News,—Spongiæ.—In a paper on the anatomy and relationships of *Lelapia australis*, Mr. Arthur Dendy calls attention to the peculiar reticulated fibrous character of the skeleton, which has previously escaped notice. This character is unknown in any other living calcareous sponge, while it forms a prominent feature in the fossil group Pharetrones of Zittel. The author accordingly regards *Lelapia australis* as a living representative of Pharetrones which family must now be classed with recent Calcarea. (Quart. Journ. Micros. Sci. June, 1894.)

Pisces.—A new species of Ribbon Fish, *Trachypterus rex-salmonorum* is described and figured by Dr. Jordan and Prof. Gilbert. According to the authors, this species bears some resemblance to *L. altivelis* described by Kner from Valparaiso. The latter species has, however, the nuchal crest much lower and farther back, the first dorsal and the ventrals much lower, the second dorsal fin higher, the skin rougher, the four black spots different in size and position from those found in *T. rex-salmonorum*, and the caudal rays divided near the base.

The type of the new species was obtained in the open sea outside the bay of San Francisco. (Proceeds. Cal. Acad. Sci. Ser. 2, Vol. IV, 1894.)

Reptilia.—In the Proceedings of the Rochester Academy of Sciences Vol. II, 1892 is published a paper, by F. W. Warner, on the Ophidians of the Southern States which contains numerous inaccuracies, and which should have been excluded or corrected by the editors of that volume.

Aves.—In a paper entitled " The Origin of certain North American Birds as Determined by their Routes of Migration," Dr. Chapman points out that the Bobolinks which nest west of the Rocky Mts. do not migrate southward with the birds of the Western Province, but retrace their steps and leave the United States by way of Florida, thus furnishing evidence of gradual extension of range westward and of the stability of routes of migration. (Abstr. Proceeds. Linn. Soc. New York, 1893-94.)

Mammalia.—The three complete skeletons and two skulls of Porpoises collected by Dr. Abbot during his recent cruise among islands north of Madagascar are identified by Mr. F. W. True with *Prodelphinus attenuatus* Gray. Dr. Abbot's notes concerning these specimens include a description of the coloration of each animal when captured so that it is now possible to correlate the external characters with those of the skeleton of this genus. (Proceeds. U. S. Natl. Mus., Vol. xvii, 1894.)

Professor J. T. Wilson regards the dumb-bell-shaped bone in Ornithorhynchus as a true " anterior vomer " formed by the fusion of bilaterally symmetrical halves ; and both in its nasal and in its palatine relations it resembles the palatine lobe of the vomer in the alligator *Caiman niger*. (Proceeds Linn. Soc. N. S. W., March, 1894.)

A collection of Mammals from the Island of Trinidad referred to Dr. J. A. Allen and Prof. Chapman for identification adds one species to the list of Bats of that Island, raises the number of known Trinidad Rodents from 7 to 19, and of indigenous Muridae from one to eight, six of which are described as new. (Bull. Am. Mus. Nat. Hist., Vol. V, 1893.)

After a critical survey of the dental and cranial characters of *Ursus cinnamomeus*, *U. arctos*. *U. horribilis* and *U. americanus* Mr. A. E. Brown reaches the conclusion expressed some years ago by J. A. Allen,

but subsequently abandoned by him, viz.: that leaving out *maritimus*, none of the North American bears can be accorded a higher rank than that of subspecies of *arctos*. This conclusion was reached after a full study of specimens of skins and skeletons preserved in the museums of America and Europe. (Proceeds. Phila. Acad. 1894.)

Eight new Pocket-Mice, described by Dr. Merriam are commented on as follows by the author.

"*P. baileyi* is a type very different from any heretofore described. It is a large animal with a peculiar skull, which suggests affinities with *P. paradoxus* on one hand, and with *P. formosus* on the other, though much nearer the latter than the former. *P. columbianus* is a peculiar local form of the *olivaceus* group. *P. nevadensis, P. panamintinus* and *P. mexicanus* are small forms with much swollen mastoids, belonging to the *flavus-longimembris* group. *P. nelsonii, P. stephensii* and *P. canescens* belong to the *penicillatus* group of the subgenus *Chætodipus*." (Proceeds. Phila. Acad. Nat. Sci., 1894.)

ENTOMOLOGY.[1]

Two New Species of Lecanium from Brazil.—*Lecanium reticulatum*, n. sp., ♀ scale long. 11, lat. 5, alt. 3 mm. Smooth, ridgeless, shiny, dark brown, rather inconspicuously spotted with whitish. These whitish spots are not dermal, but consist of small patches of waxy secretion, which can easily be scraped off. Posterior incision 3 mm. long.

Derm very strongly reticulate, reticulations large, 3, 4, 5 or 6-sided, each with a large oval gland-spot, placed more or less to one side. Walls of reticulations very thick. This reticulation of the derm is easily seen with a lens.

Legs brown, ordinary. Coxa with two hairs at one end, one very long; tibia a little less than one-third shorter than femur; tarsus about one-quarter shorter than tibia.

Tarsal digitules very long, slender, with only moderate knobs, which dilate rather gradually.

Claw short, stout, curved. Digitules of claw small, but extending considerably beyond tip of claw, one larger than the other, stout, with only moderate knobs.

Removed from the bark the insect leaves a patch of white secretion.

A parasitised specimen is only 8 mm. long, and is yellowish-brown, with the reticulation black, very conspicuous with a lens; margin blackish. The parasite must have been a large one, the single hole being over 1 mm. diameter.

Hab., on twigs of an unidentified woody plant, Sao Paulo, Brazil (Dr. H. Von Ihering).

Three were sent, one spoiled by a parasite, the other two in good condition. One of the latter I boiled in caustic alkali, but was not able to obtain all the desirable details from it. The imperfection of the description does not particularly matter, since the species is very easily recognized. It is closely allied to *L. depressum*, Targ., but differs in its very much greater size.

Lecanium baccharidis, n. sp., ♀ scale long. 4½, lat. 2½, alt. 1¼ mm. Dark brown, becoming eventually whitish-brown from a waxy or cottony material scattered over the surface. Where one scale overlapped another, the portion covered is bright orange-yellow with a greenish

[1] Edited by Clarence M. Weed, New Hampshire College, Durham, N. H.

tinge. Surface wrinkled, but this no doubt largely due to contraction in drying. Dorsum slightly ridged. Posterior cleft fairly short.

Derm with large gland-pits; not at all reticulate. The pits are strikingly large and numerous.

Legs pale brown, ordinary. Trochanter with a long hair; tibia about one-third longer than tarsus. Claw stout, not very long, curved.

Tarsal digitules filiform, not unusually long. Digitules of claw very stout, with large knobs.

Margin with long straight spines.

Rostral loop short, not reaching to insertion of middle legs.

Anal plates broad, when flattened not far from equilateral, but as ordinarily observed in situ with the posterior external side considerably longer than the anterior external side, the two meeting at about a right-angle.

Anal ring with very numerous hairs, which cannot be counted separately.

Antennæ pale brown, 8-jointed, the joints all very distinct. 3 longest. Formula 3 (24) (18) 567. 7 only a little shorter than 6. 4 about ⅓ shorter than 3. 8 only a little shorter than 4, tapering.

The larger specimens seem quite adult, though they contain neither eggs nor larvæ.

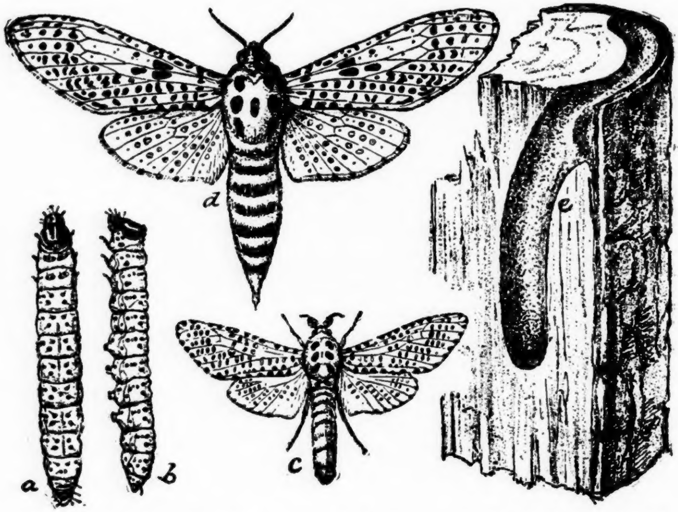
Hab.: Sao Paulo, Brazil, on bark of twigs of *Baccharis* sp., two or more scales sometimes overlapping. (Dr. H. Von Ihering.)

This has the general form and size of *L. hesperidum* (L.), but is a rougher, more opaque form. I do not think it is nearly related to *hesperidum*, such resemblance as exists being merely superficial.

T. D. A. Cockerell, Experiment Station, Las Cruces, N. M.

The Wood Leopard Moth.—There have been frequent reference during the last two years to the ravages of *Zeuzera pyrina* L., a lepidopterous borer of shade-trees, which has been introduced from Europe, and is doing great damage in the parks of New York, Brooklyn and adjacent cities. The various stages of the insect are shown in the accompanying figures from *Insect Life*. Its life-history has recently been summarized by Prof. J. B. Smith, as follows:

"The moths make their appearance in May or June, continuing through July and into August, and are readily attracted to light. It has become the most common species seen around the electric lights in the cities named, and each moth represents a larva that has fed for at least two years in the wood of a neighboring tree, while every female represents the possibility of hundreds of other larvæ to follow the same life history.



The Wood Leopard Moth.—*a*, *b*, larvæ; *c*, male moth; *d*, female moth; *e*, larval burrow. All natural size.

"The eggs are laid by the female moth on the branches, probably placed just into the bark, and the young larvæ bore at once into the wood, usually at the crotch of a small branch, or at a node, and work downward, sometimes just under the bark, sometimes in the solid wood. They grow apace and get into larger branches, still working downward as a whole, but often varying in course; sometimes making it circular, so as to girdle the stick they feed in. For at least two years they feed, rarely emerging from the burrow, though they do occasionally come out for the purpose of changing their quarters and beginning their destructive work elsewhere. Then they change to somewhat slender, brown pupæ, and these wriggle themselves through the bark in due season, and soon after the moths emerge."

The moths, fortunately, are attracted to electric lights, and large numbers of them are thus destroyed. The larvæ may be destroyed by pouring a little bisulphide of carbon in the burrows and then plugging the outer openings of the latter with putty.

Relaxing Insects.—J. P. Mutch writes in *The Entomologists Record* that "rectified wood naphtha, obtainable from any chemist, containing a trace of white shellac, say ten grains to the ounce, applied

to the under side of the extreme base of the wings by means of a very fine sable brush, within a few seconds renders the wings quite pliable; the insect is then placed on the setting-board and set to the required position, braces being used if necessary. In from twelve to twenty-four hours the specimen is ready for the cabinet, showing no trace of the manipulation it has undergone. The shellac is recommended to prevent any possible future springing or drooping, but the pure naphtha produces an equally satisfactory effect so far as relaxing goes. The old, tedious process of damping may thus be obviated, and the most delicate colors left uninjured."

Eyes of Phalangiidæ.[2]—Herr F. Purcell finds two types differing in the structure of the rhabdome—the Liobunum type and the Acantholophus type, and describes these in detail. We can only cite a few outstanding results.

One of the most important characteristics of the retina is the constant arrangement of its elements in groups (retinulæ), each of four cells, and the union of the optic rods of these four cells into a rhabdome, which, though single, is composed of four rhabdomeres. There are no pigment or other cells between the retinulæ.

In all the species examined the rhabdome consists of two chemically different parts. The one part includes the whole central rhabdomere, and in the Acantholophus group the distal portion of the peripheral rhabdomeres. The other part includes in the Liobunum group the whole of the peripheral rhabdomeres; in the Acantholophus group only the proximal part of the same.

The eyes of the Phalangiidæ are three-layered inverse eyes of ectodermic origin. The anterior median eyes of spiders, the eyes of Phalangiidæ, the median eyes of scorpions, and at any rate the median eyes of the king-crab, form a series of homologous structures, characterized by an inverted retina with retinulæ or at least rhabdomeres. As a chief result of his investigation the author claims to have definitely proved that a retina composed of retinulæ, or of a modification of these, occurs in the higher Arachnid orders—Phalangiidæ and spiders. (Journal Royal Microscopical Society.)

Spread of Otiorhynchus ovatus.—Mr. H. F. Wickham publishes in *Societas Entomologica* (Dec., 1894) a short paper on the distribution of *O. ovatus* of such interest that we reprint it entire:

"This Euro-Asiatic species has been for some time known as an inhabitant of the United States, but has hitherto been supposed to be

[2] Zeitschr. f. Wiss. Zool., LVIII., pp. 1–53.

restricted to that portion east of the Mississippi River and north of the thirty-ninth or fortieth parallel. I have lately become possessed of additional data regarding its range, which I herewith record, adding also a number of already published but scattered notes—the whole giving a tolerably complete idea of the American distribution of the insect.

"When known, the year of first capture is also given, though often we can only tell from the date of a given reference that the species was known in that locality *previous* to that time; hence no exact generalizations as to the path or rate of westward progression can be based thereon. A considerable portion of the matter, however, has been gathered directly by correspondence with entomologists in various parts of the country, who have kindly responded to my requests for information, and whose names will be found appended thereto.

"In a recent number of *Insect Life* it is stated by Messrs. Riley and Howard that it was first recorded from the United States in 1873. Not being able to find the reference, I wrote to Mr. Samuel Henshaw, asking help of his unsurpassed knowledge of the bibliography of American beetles. He kindly replied as follows:

"'The Leconte collection contains a specimen of *ovatus*, No. 1952 of his manuscript catalogue. Against this number Dr. Leconte wrote "pear tree, Harris, Mass." As Harris collected all his beetles between 1820 and 1852, *ovatus* must have been here (Massachusetts) as early as 1852. The late Mr. J. P. Atkinson collected the species at Cambridge Sept. 2d, 1865, and there is a specimen in the Leconte collection taken by Mr. Schwarz in Cambridge, March 20th, 1874. My earliest specimen is labeled Wyoming, Mass., May 30th, 1874.'

"It was thus evidently established in Massachusetts by this time; a year later it was at Allegheny, in Pennsylvania, as Dr. Hamilton writes me from that place. 'I took this beetle in a cemetery here in 1875, and it was then apparently abundant. A couple of years afterward it was excessively so, in the same cemetery, but is now (1894) much less common than formerly.' By 1878 it had reached Detroit, Michigan, when it is recorded in the Hubbard and Schwarz List. Mr. Henshaw had it from Hanover, New Hampshire, as early as 1880. In 1884 it came under Dr. Lintner's notice in New York, but Mr. Reinecke found it at Buffalo at least two years earlier. About 1882 or 1883 it figured as a strawberry pest in Southern Michigan, and the year 1884 brings a record from Ottawa, Canada, by Mr. Harrington. Not later than 1886 I took it at Iowa City, the record standing for years as the most westerly range known for the species.

In the East, however, it was still being taken at new points, as the following notes show, the dates being those of publication: Nova Scotia, 1889; Chicago, Illinois, 1889; Wayne County, Ohio, 1892; Quebec, 1892; Indiana, 1892; New Jersey. The western range has been greatly extended by the capture of this insect at Laramie, Wyoming, in 1893, by Mr. Niswander, and at Santa Fé, New Mexico, by Mr. Cockerell, in July, 1894. the specimens in both cases being sent me for identification.

"It will thus be seen that the recorded distribution is very much extended of late, and the species by no means restricted in range. Though the dates are insufficient for the tracing of the exact path of the insect, it at least appears to have slowly spread westward and southwestward from the New England States, where it may have been introduced from Europe. From the scattered records and the absence of *O. ovatus* from many points within its range, worked by diligent collectors, I judge that it is not very aggressive in invading new territory, but doubtless tolerably easily introduced in shrubbery or other nursery stock.

"A word as to food-habits here, and I am done: Dr. Hamilton takes it on various bushes. It has been recorded from muskmelon (Webster), strawberry (Weed), borage (Cook), currant (Mrs. Wickham). Mr. Webster also found it breeding in roots of blue-grass. At Iowa City it has been found under boards, and often in bunches of pine shingles. The habit of thus creeping into crannies would greatly aid in extending the distribution by artificial means and explain its appearance in new localities where it could not have been introduced with plants."

EMBRYOLOGY.[1]

Development of an Isopod—The first paper of M. Louis Roule on the development of the Crustacea has just appeared.[2] He has studied, as a representative of the Edriopthalmia, the Isopod, *Porcellio scaber*, Leach, with especial attention to the first stages of development. The origin of the blastoderm, of the germ layers, and of the rudiments of the organs, are considered in great detail, and there is, besides, much general discussion on the significance of these processes among Arthropods. This first paper will be followed by three others; one on the Decapods, one on the Copepods and Branchiopods, and a third on general questions.

Though Bobretzky, in 1874, established the chief features of the development of Isopods from a study of *Oniscus murarius*, a detailed examination of the development of the group was much needed; and M. Roule has also wished to throw more light on the question of relationship between Annelids and Arthropods. He has been led to believe that the early stages of the Crustacea do aid us materially in testing such an affinity.

The eggs of *Porcellio scaber* develop in the brood chamber of the mother, the early stages (including segmentation, the formation of the blastoderm, and establishment of the germ layers) requiring a proportionately long time, about two weeks, while the rest of embryonic development takes but three weeks.

The unsegmented ovum is mainly a mass of nutritive yolk, with the greater part of the formative material on the surface in the form of "*islands*" of protoplasm. The food yolk consists of a great number of large vitelline granules in a protoplasmic groundwork. Toward the periphery the granules are smaller, and the islands of formative yolk, though finely granular, are mostly formed of the protoplasmic groundwork. In a surface view one of the islands of protoplasm is found constantly at the anterior pole, and is seen to be larger than the others. This is the germinal disc, and it contains the only nucleus in the ovum. The other islands have no constant position or size; they are continuous with the central deutoplasm (as is also the germinal disc),

[1] Edited by E. A. Andrews, Baltimore, Md., to whom abstracts, reviews and preliminary notes may be sent.

[2] Annales des Sciences Naturelles, Vol. xviii, Nos. 1, 2, 3 (sér. 7), with 10 plates.

and separated from one another on the surface by deutoplasm. The nucleus in the germinal disc divides, and its descendants scattering in the protoplasm form a syncitium adherent to the surface of the food yolk. As the disc spreads, the central protoplasm divides up into cells around its nuclei, while the periphery remains a syncitium. This syncitium is soon broken up into cells, and as the blastoderm thus formed extends, it annexes more formative material as it reaches the islands of protoplasm. The periphery of the blastoderm is thus continually added to, and the protoplasm forming the growing edge is constantly supplied with nuclei from the centre of the disc, around which in their turn new cells are formed. Besides the protoplasm added from the islands, formative material is also supplied from the centre of the ovum among the deutoplasm. In this way the blastoderm gradually extends over the egg from the anterior pole ventrally and laterally, until it finally closes in at the posterior pole near the dorsal surface. (This type of segmentation seems to fall between Korschelt and Heider's III b. and IV.) Soon after the first cells of the blastoderm have become well defined at the anterior pole, they begin to split off an under layer, the mesentoderm (Roule's protendoderm). This layer is steadily added to as the blastoderm spreads, by a repetition of this process of splitting tangentially, by incorporating new cells thus formed at the anterior edge of the blastoderm, and by a division of its own cells. The anterior pole of the egg is the growing point of the mesentoderm. The cells lie for the most part along either side of the ventral mid-line, in two ridges projecting into the yolk, in the anterior region of the embryo. The cells being amoeboid, however, wander dorsally and posteriorly, where they lie as elsewhere in the outer portions of the deutoplasm. By this time the cells of the ectoderm have flattened, except in two regions, into a single layer. At one place where the brain is to appear, a rapid division of nuclei and fusion of cells takes place, until a syncitium is formed projecting into the yolk. A similar syncitial mass is formed on the ventral mid-line, to be the ventral cord. These two areas are connected by ectoderm, which will later be the œsophageal ring. Nineteen pairs of appendages gradually appear from before backward. At first they are formed of an ectodermic sheath with a core of nutritive yolk and scattered mesentoderm cells; but soon the nutritive yolk is absorbed, leaving merely the mesoderm cells within. While the nervous system is becoming more distinct, and the appendages are growing and increasing in numbers, a proctodeal invagination, which appeared at the point where the blastodermic disc closed in, and a stomodeal invagination, which appeared at the

anterior pole, both grow into the yolk mass towards the centre of the egg. The proctodeum is a narrow, straight tube, which finally reaches the anterior portion of the body and comes into contact with the stomodeum. The latter begins in a short, straight œsophageal portion at the base of the mandibles, which is distended at its central end into a vesicle resting against the blind end of the proctodeum.

The most striking changes during this period are, however, found in the mesentoderm. It becomes differentiated into two layers, mesoderm and endoderm. The mesentoderm (or protendoderm) has, as has been seen, collected especially in the anterior end of the body, on either side of the median line. In the rest of the body it formed a layer of scattered cells in the surface of the yolk under the ectoderm. The lateral anterior masses become slowly marked off into a dorsal and a ventral portion. The dorsal portion forms a plate of cells on either side of the median plane in the anterior region of the body. The ventral part forms two ridges of cells (one on either side of the ventral mid-line), which are numerous, closely packed, and run down into the appendages. At the base of each pair of appendages there is a collection of these cells, to become muscles of the limbs. This gives the mesodermic ridges a metameric appearance. The two lateral dorsal plates become more and more clearly defined and enlarged. They are concave toward the yolk mass enclosed between them, and as they grow and meet on the mid-line, they unite. In this way a mass of yolk in the centre of the embryo is gradually included in a layer of cells, endoderm, originating from the mesentoderm. Since, however, the union of the endodermic plates is gradual, and since they meet first anteriorly and ventrally, the enteric vesicle formed by them is open behind and above for some time. The endoderm is now distinctly marked off from the rest of the mesentoderm, and has arisen from anterior lateral collections of this layer and from its dorsal portion. The rest of the mesentoderm becomes mesenchymatous mesoderm. It is found everywhere beneath the ectoderm, especially ventrally. One other thing is more and more evident in this region, where the mesoderm is collected most: the yolk has been absorbed gradually, and the mesenchymatous elements are here bathed in plasma. This absorption of yolk will continue rapidly from now on, proceeding from the ventral toward the dorsal surface of the embryo.

During the last period of development profound changes take place, ending in the fully-formed young crustacean ready to leave the egg-membrane. The ectoderm soon secretes a cuticle, while the appendages elongate and become segmented. Those belonging to the head draw

together around the mouth, and those in the abdominal region flatten and become pleopods; while the thoracic limbs become the longest appendages of the body, with the exception of the second antennæ. At first there is no external segmentation of the body, but gradually a head region is marked off from the thorax by a groove. Posteriorly, the thorax and abdomen are also pretty clearly marked, the latter being of smaller segments. The grooves between the segments appear first ventrally and grow up towards the dorsal surface. Later dorsal grooves appear and grow down to meet the ventral ones. Finally the abdominal, and the two or three most anterior thoracic segments, are completely marked off by circular grooves. The thorax is the last region to become segmented. Its mid-dorsal portion is raised into a peculiar hump, which is very prominent for a time, but gradually disappears as the development proceeds to a finish.

The proctodeum and stomodeum have gradually approached and met in the thoracic region as described, and finally the point of union breaks through, and the digestive tract is continuous in its whole length. In the first period the enteric vesicle had become almost entirely closed in around a mass of yolk in the centre of the embryo; now it is entirely closed and becomes greatly changed. A deep groove pushes in along its ventral surface from in front backward. It deepens towards the dorsal surface, and finally meets a groove from above. They split the enteric vesicle into two halves which are however united anteriorly by an unsplit portion. This anterior stem, bearing the two enteric lobes behind, (later on the two primary enteric lobes split into two secondary each) lies just at the point where the proctodeum and stomodeum meet, and where their cavities become continuous it opens into the alimentary canal thus formed. As M. Roule says: "Such a disposition is found among all crustacea, with the constant relation of the enteric vesicle with its lobes attached to the digestive canal in the zone of union of the anterior and posterior intestines." "Considering the entire digestive tract then, the whole system, canal and annexes, originates from three rudiments which are at first independent of each other and later joined into a single system. Two of these, the stomodeum and proctodeum, arise from the ectoderm, while the third comes from the entodeum. A like structure and like triple origin is to be found in the other Arthropods, but with an important difference: the proctodeum does not extend so far into the body as that of the Crustacea; its anterior end remains some distance behind the enteric vesicle; it unites with the enteric vesicle at its posterior end,

while the stomodeum joins the vesicle at its opposite end. The enteron is thus interposed between the anterior and posterior intestines, becomes a part of the digestive canal and forms the mid-gut, which Crustacea almost completely lack." The endoderm, hence, arises internally from the protendoderm, and not by invagination. There is no gastrula among Arthropods, the apparent gastrula invaginations being really stomodeal invaginations. The alimentary tract arises from three rudiments in an entirely different way from the process followed in animals with true gastrulation. Every little depression on the Arthropod blastoderm, M. Roule says, has been thought to be a gastrula when once the necessity for finding one was thought established by the early workers on the germ layers. However, gastrulation is not so important as the results of it, and M. Roule suggests that a very important difference between Arthropods and other Cœlomates is the fact that their digestive tract is not formed from any of the so-called gastrulas.

(It will be noted that Heymons, in a recent paper, has also given up the idea of endoderm formed from a gastrula invagination, deriving the whole digestive tract in insects from the stomodeum and proctodeum. Korotoneff, too, has adopted Heymons' view to a great extent.)

As development proceeds, the yolk enclosed by the enteric vesicle is gradually absorbed, the brain and ventral cord become differentiated, and the yolk mass in the body cavity is rapidly reduced. This reduction is effected by phagocytes floating in the plasma, which washes the edges of the yolk. They eat it away until it is confined to the dorsal portion of the thorax, where it forms the hump mentioned above. Besides these wandering cells, other cells of the mesoderm elongate become grouped together and form muscle bands criss-crossing through the body cavity. By the end of this period all trace of metamerism has vanished from the mesoderm. The appearance of metamerism, noticed at an early stage, was due to collections of mesoderm cells at the bases of the successive pairs of appendages, before they had pushed out sufficiently to accommodate those cells destined to shove in and form the inner structures of the limbs. The disappearance of this apparent metamerism in later stages is due to the segmental collections of cells having moved into the limbs to their definitive position. "This fact shows undoubtedly how the metameric disposition of the ventral mesoderm is bound up in the distribution of the appendages in regular pairs as cause to effect. The first is the result of the second, and has no other value whatsoever."

In speaking of the external segmentation of the body, M. Roule says:

"The annelidan structure of the organism manifests itself at a later date than the production of the appendages. The folds between the rings pass rigorously between the pairs of appendages. The relation of cause and effect is apparently evident. This structure is, as the temporary metameric disposition of a part of the mesoderm, a result of the presence of limbs on the body and of their distribution in pairs placed regularly one behind the other at equal or almost equal distance apart. The object is to facilitate movements of the body especially flexion, and is of no other importance. The morphological value of this segmentation of the body into a metameric series is hence most plain; it is secondary, and not primitive, in spite of its analogy to annelids and vertebrates, and it is to be associated with the existence and arrangement of the paired appendages."

In another place the difference between the metamarism in the two groups is put as follows: "In the annelids the metameric division of the mesoderm is due to a regular increase of cavities in this layer from one end to the other. The appearance of such spaces is not at all dependent on the presence of appendages, for it precedes their origin and takes place even when they are lacking. Finally these cavities enlarge equally and surround the intestine."

As to the Arthropods: "Only a part of their mesoderm assumes a metameric appearance, the rest remaining mesenchymatous. This segmental arrangement is not at all a result of multiplication of cavities, but the result of a compact grouping of cells due to an inequality in multiplication. The spaces which appear finally in the mesoderm are irregular, numerous, and in no way related to the segmental arrangement. This is dependent on the presence of appendages, since it is established after these are produced and so that a metamere lies above each appendage. The relation is so intimate as to compel the inference of cause and effect. Finally, in no case do the mesodermic cavities enlarge in a regular way to surround the intestine."

Before the embryo is set free, the hump on the back, due to the yet unabsorbed food yolk in the dorsal part of the body cavity, disappears on the complete absorption of this yolk. This hump has been described as a "dorsal organ," but it is easily seen to be no organ at all, merely the last of the food yolk.

M. Roule devotes considerable space to the establishment of his view as to the formation of the germ layers in Arthropods and their homologies with those of other cœlomates. He regards the whole process of the spreading of the disc-shaped blastoderm as a process of planulation. No epibolic gastrula is formed, he claims. The planulation

consists in splitting a central layer of cells belonging to the food yolk from a superficial ectoderm. The protentoderm does not arise, according to this, from the ectoderm, but both layers are the result of a division of the blastoderm. Just as in any planula of this sort (lecithal), there is an external epithelial layer of cells, while the internal ones are connected with the yolk.

Other Crustacea show a simpler and more typical planula. Here, after a total segmentation resulting in a collection of pyramidal cells, the central ends containing the yolk divide off, forming an inner layer of cells (protendoderm), while the peripheral remains as the ectoderm. In the Isopods the mesentoderm separates from the yolk mass as amœboid cells. In insects the condition is more complicated, but essentially the same. The cells produced from the formative yolk travel to the periphery and become the blastoderm, which divides as in the Crustacea into the mesentoderm and ectoderm. The cells from the centre, which do not reach the blastoderm before its splitting into two, are really blastoderm cells retarded from becoming ectoderm. They become mesentoderm cells. M. Roule distinguishes them by the term "inner blastoderm."

"By whatever method formed, the resulting planula is composed of a peripheral blastoderm and a central deutoplasm. It is centrolecithal. This planula is peculiar to Arthropods and some Hirudinea."

"The lecithal planula of other animals belong to Cephalopods, some Tunicates, and many vertebrates (Teleosts, Selachians, Sauropsida). Here, too, the central yolk mass is enclosed by a disc gradually spreading over the surface; but in these cases the blastoderm divides into two parts, one thick, situated at the place where the disc started to spread, and alone destined to give rise to the embryo, while the rest is reduced to a thin membrane, limiting the yolk and absorbing it, but not forming any part of the adult. These two portions of the blastoderm are the embryonic zone and the vitelline zone. They are contiguous, and the nutritive mass is not placed in the interior of the young individual. In Arthropods the condition is quite different. The blastoderm is entirely embryonic, and encloses all the deutoplasm which forms an *internal* vitelline vesicle, and not a contiguous one. The centrolecithal condition of the planula and the genetic unity of the blastoderm so constant among Arthropods, lends to these creatures an autonomy separating them from other cœlomates."

The germ layers of Arthropods are not, according to M. Roule, homologous with those of other cœlomates. The ectoderm, however, he believes to be homologous in origin and history in all cases. Homology

means to him identity of origin in time and space, and he believes that two systems with like fates, but dissimilar origins, are not homologues.

The protendoderm of Arthropods is a mesenchymatous tissue arising by migration, as in a planula of the hydrozoa. That of other cœlomates is epithelial from the start, and arises by gastrulation. Hence, in origin and character the two are essentially different.

"The investigations of many observers on the development of sponges and hydroids have shown that in the cœlenterates the germ layers may be formed by other processes than gastrulation. To-day it seems to M. Roule impossible to consider the germ layers of the metazoa as homologous. They differ from one another in origin. The protendoderm (mesentoderm) of Arthropods does not correspond to that of other Cœlomates; but among Arthropods it is homologous, and among other cœlomates it is homologous. The difference between the lecithal planula of Arthropods and similar ones of other cœlomates lies in the origin of the endoderm in the latter by a true gastrulation.

H. Mc. E. Knower.

ARCHEOLOGY AND ETHNOLOGY.[1]

Discovery of Shell Mounds in Chira Valley, Peru.—It was my good fortune, during the last four years, to discover in the Chira Valley in the northern Part of Peru, a vast field of antique remains hitherto unknown to the scientific world. The Chira River which is the most northernly of the important coast streams running from the Andes to the Pacific, is situated about one hundred and fifty miles from the frontier of Ecuador, and nearly six hundred miles to the north of the great Ancon necropolis, recently so exhaustively studied by Reiss and Stübel. Between the Chira and Ancon are two fields already well known—one the great Chimer and Trujillo and the other near Chimbote in the Santa Valley--Trujillo lies some 225 miles to the south of the Chira.

Fifty or sixty miles north of the Chira is a smaller valley called the Pariñas. Between the two is a desert region extending inland to the La Brea Mountains, a distance of thirty miles. These two valleys and the intervening territory, an area of 1800 square miles, comprised my field of work. The exact locality may readily be determined upon any map of South America as it embraces Point Pariñas which is the most westerly Cape of the Southern Continent.

It was among the ruins and graves of the Chira Valley that I gathered the Collection of Antiquities now deposited in the Museum of the University of Pennsylvania. These ruins and graves occupy as a rule all the untillable land on the northern side of the valley from the town of Sullana to the mouth of the River, a distance of forty or fifty miles. The ruins are unique among those I saw in Peru. They lie in groups four or five miles apart and consist of terraced temple platforms of three stories, built of clay reinforced with conical shaped adobes. The whole edifice is about three hundred feet in length and breadth at the base and seventy-five feet in heighth. Adjoining these pyramidal structures are always found extensive traces of adobe walls, doubtless the remains of the foundations of priestly dwellings, for it is fair to suppose that these monuments had a sacred character. At the foot of the ruins are arranged numerous hillocks thickly covered with small white bivalve shells. Under the shells the soil is full of fine ashes and sherds of pottery. The surrounding plain is always crowded with graves, often three or four tiers deep to a depth of twenty-five feet. A

[1] This department is edited by H. C. Mercer, University of Pennsylvania.

feature of these graves seems to prove one of the statements made by Cieza de Leon in his account of the Civil Wars in Peru. According to him the natives of this northern region were in the habit of sacrificing at their burials and of throwing the remains of the sacrifice into the grave. In excavating I found the soil above the graves thickly mingled with charcoal, burnt bones, ashes and other refuse. In addition to this refuse I also encountered numerous white shells, both bivalve and spiral, in the sand, and the entire surface of the necropolis is lightly covered with similar shells which have probably been washed out by the rains. As it is to the constant occurrence of the small white shell in the graves and other remains of this region that I wish to draw attention, I shall omit here any description of the graves themselves.

In the Pariñas Valley the ruins are less elaborate in character. At the mouth of this river, close by the sea, is a large artificial mound about an acre in extent and thirty-five feet high, filled with bones and fragments of coarse pottery. Occasionally it is possible to find a rough pot or olla of burnt clay. Close to this mound are several smaller ones of similar character. All of these, including the great mound, are covered on the surface with the white shells. Throughout the valley, wherever natural elevations have been used as burial places, these shells again occur and the pottery of the graves is of the same low order. Ruins of adobe walls, sometimes buried several feet below the present level of the valley, are also to be found at several places along the Pariñas River.

There are in the desert itself three or four wells in the neighborhood of which are buried ancient walls. Associated with these walls we invariably find some natural elevation, containing bones and pieces of pottery, covered with the shells as in the Pariñas Valley. Everything seems to indicate that these ruins at the wells and along the Pariñas belong to much earlier epoch than those which exist in the valley of the Chira.

In the very heart of the desert, however, I found remains of an entirely different order. These are situated about twenty-five miles south-west of Point Pariñas four miles from the sea shore. At this point for several square miles the plain is crowded with irregular mounds, some forty or fifty feet in height, composed entirely of white bivalve shells slightly mixed with sand. These might be taken for natural formations were in not that each contains a central core which is filled with charcoal, burnt shells and other signs of fire. Owing to my work in other directions I was not able to devote much time to these mounds. Although repeated digging revealed neither bones nor

pottery, I am convinced from the charcoal and other indications that these remains are of human origin and I am thus able to make known for the first time the existence of the true shell mound in Peru. That these mounds are mere heaps of loose shells rather than compact masses, as in Florida, and other places is no argument against their great antiquity, for in the practically rainless desert region in which they are found they might easily have remained unchanged for many ages.

Before attempting to draw any conclusions from the data afforded us by the different classes of remains which exist in this locality about the Chira Valley, it will be necessary ta take a brief survey of what is known of its history. We have but one authority on this subject, Garcilasso de la Vega, and although his account is far from being a model of either history or chronology, it is certainly based upon tradition and is therefore full of suggestion. When the Incas set out to conquer the coast valleys they found them occupied by a warlike and well advanced race called the Yuncas, whose chief centre of power extended from the Chincha Valley near the modern Pisco, to the great Chimu at Trujillo while their dominion reached over all the surrounding tribes. According to their own legends these Yuncas were of foreign origin, and their ancestors, after affecting a landing in Peru, had through sheer innate superiority conquered their barbaric neighbors, and laid the foundations of the great nation which in time grew to the proportions in which the Incas found it. After subduing the Yuncas, the Incas proceeded northward and in the remote valleys of that region encountered a people of so low a condition, so poor and bestial that it was necessary to compel them to pay tribute in lice in the hope of teaching them the rudimentary principles of cleanliness. The Chira was one of these outlying valleys, but the millions of graves which it contains and the high civilization which they reveal, prove at once the chronological inaccuracy at least of de la Vega's story. It is probable that his errors arose from confusing Incan and Yuncan traditions, and that it was the Yuncas and not the Incas who came in contact with the barbarians.

It is hardly possible to suppose that the people of the shell mounds could ever have risen through their own efforts to so high a level as was obtained by the inhabitants of the Chira; it is even improbable that they could have done so with the aid of extraneous influence. A more likely theory is available. Before the coming of the Yuncas, a shell mound tribe occupied the desert adjacent to the mouth of the Chira and were either exterminated by invaders or had ceased to exist before their arrival. After the manner of all semi-civilized or semi-

barbaric peoples the new comers regarded the gleaming white shell mounds of their predecessors with superstition, attached to them a sacred significance and were not long in incorporating the shell into their own ritual. This we see in the shell *covered* mounds and burial hills of the Pariñas Valley. In the Chira Valley we find that an advance has been made, the burial mound of the Pariñas here becomes the temple platform and the shells appear on the hillocks surrounding it and in the grave fillings. It is true that these hillocks seem to have been ovens in which pottery was baked, but this in no way alters the significance of the shells which cover them. The pottery, especially the fantistic and carefully finished pieces found in the graves, must have had a ritualistic meaning and the ovens in which it was baked must also have been regarded as sacred, and when no longer used were consecrated with a covering of the revered shells.

A more difficult problem seems to present itself in the difference which exists between the remains of the Pariñas and those of the Chira. Tradition again aids us in overcoming it. There is a story that the Pariñas Valley was once thickly populated (it is now practically uninhabited), and that for some reason, probably drought or plague, the people were compelled to abandon it and seek homes in the valleys to the south. This migration probably took place prior to the epoch in which the custom arose of symbolizing the mound in the temple, and before the pottery art was so highly developed as it latterly became. This desertion of the Chira Valley at so early a period has therefore preserved for us an important link in the chain of the nation's progress.

This view of the adoption of the shell of the old kitchen mounds as a sacred token by the conquerers or successors of the primitive race, serves also to explain the comparatively limited extent of such mounds, for undoubtedly the shells of the graves and ruins were obtained from these deposits and in this way many of the old mounds were destroyed. This theory also accounts for the absence of shells in the other grave fields of the coast.

As I said before this necropolis of the Chira is new to science and is deserving of attention and exploration. It presents many unique features in Peruvian Archeology. The bodies are buried horizontally at full length, with the head resting on the left shoulder and the face turned in the same direction, whereas in other regions the body is invariably trussed up in sitting posture with the knees drawn under the chin. I also found that the use of the lábret was common among the females, a custom hitherto unknown among the tribes of the coast regions of Ancient Peru.

From the tools and other implements which I brought back, Mr. Frank Hamilton Cushing of Washington has been able to prove that the lacquer art was known to those people; that the goldsmiths art, of which it is possible to show all the processes, was very cleverly practiced, and lastly he has been able reconstruct for the first time the ancient Peruvian loom and to demonstrate the methods by which all the intricate fabrics of that time were woven. It is sincerely to be hoped that before long he will be able to present these wonderful and most valuable discoveries to the world.

—SAMUEL MATHEWSON SCOTT.

Mr. H. A. Pilsbry, of the Academy of Natural Sciences of Philadelphia, has kindly identified the shell specimens collected by Mr Scott at these shell heaps, as *Spondylus princeps* (Brod.), Gulf of California, etc.; *Natica panamensis* (Recluz.); *Trivia radians* (Lam.), St. Elena, west coast of Columbia, *Donax radiatus* (Valenc.), Mazatlan to Valparaiso; *Terebra fulgurata* (Philippi), Mazatlan. The large thorny Spondylus would, he says, roast well. The delicate little Donax would make excellent soup, and the Natica would be found as edible by the Peruvian Indian as its Periwinkle brother has been by the North American Red Man, whose shell heaps and village sites are thickly strewn with it. The modern Londoner, as Mr. Pilsbry informs me, eats tons of the same snail yearly. Minute Terebræ and Olivæ, if not boiled for soup, might have done for trinkets.

H. C. MERCER.

The Neanderthal Man in Java.—Dr. Eugene DuBois of the Army of the Netherlands has recently published in Batavia, Java, in a brochure in quarto, an account of some bones of an interesting quadrumanous mammal allied to man, which were found in a sedimentary bed of material of volcanic origin, of probably Plistocene age. The remains consist of a calvarium which includes the supraorbital ridges and a part of the occiput; a last superior upper molar; and a femur. The tooth was found close to the skull and probably belongs to the same individual as the latter, while the reference of the femur is more uncertain, as it was found some fifty feet distant.

The characters of the skull are closely similar to those of the men of Neanderthal and of Spy, but the walls are not so thick as those of the former, and more nearly resemble those of the latter. The frontal region is, therefore, much depressed, and it is also much constricted posterior to the postorbital borders. The sutures are obliterated. Much interest attaches to the cranial capacity, which Dr. DuBois

states to be just double that of the gorilla, and two-thirds that of the lowest normal of man, bridging the gap which has long separated the latter from the apes. Thus the capacity of the former is 500 cubic c. m.; and the latter is 1500 c. c. m. In the Java man the capacity is 1000 c. c. m. The last upper molar has widely divergent roots as in apes and inferior races of man, and the crown is large, with the cusps not clearly differentiated, showing a character commonly observed in the lower molars of the gorilla. The femur is long, straight, and entirely human.

This important discovery of Dr. DuBois adds materially to our knowledge of the physical characters of the paleolithic man, and especially to his geographical range. As is well known, his remains have been found hitherto in Europe only, (Neanderthal, Spy, Naulette, Shipka, etc.), but now it is evident that he ranged over almost the entire width of the Old Continent. This discovery confirms the anticipation expressed by evolutionists, including those published in the NATURALIST for April, 1893, (The Genealogy of Man), and October, 1894.

As regards the proper apellation of this being, Dr. DuBois is not entirely happy. He proposes for him a new genus, Pithecanthropus, (after Haeckel), and even a new family, Pithecanthropidæ, without having shown that he is not a member of the genus Homo. It is not certain that he is not an individual of the species *Homo neanderthalensis.* His cranial capacity is less, it is true, than that of the man of Spy, and it is possible that this really constitutes a character of specific value. Disusing then, Dr. DuBois' name Pithecanthropus, we have left as the appellation, *Homo erectus* DuBois. This name is distinctly absurd, as it is applicable to all members of the genus Homo. The law of priority, however, requires that we use it in case the species is new.

It is interesting to observe the differences of opinion expressed by paleontologists as to this discovery. Prof. Marsh, in a late number of the Amer. Journ. of Sci. and Arts, adopts Pithecanthropus and Pithecanthropidæ; while Dr. Lydekker, in Nature, expresses the opinion that the remains belong to a microcephalic idiot.—E. D. COPE.

MICROSCOPY.[1]

On a New Method of Entrapping, Killing, Embedding and Orienting Infusoria and other very small Objects for the Microtome.—A reliable method for capturing, killing, staining and dehydrating minute organisms has long been a desideratum with biologists, especially when such objects fall far below 1–100th of an inch or 1–40th mm. in diameter. After trying a number of devices, all of which failed, I fortunately hit upon a plan that is not only very simple, but also capable of wide application, since I find that by its means organisms as small as 1–2000th inch or 12.5μ in diameter may be caught and held.

With the ordinary methods of filtration through the filter paper it is not possible to afterwards separate minute organisms thus captured from the surface of the substratum of paper. This difficulty has been overcome in my new method by means of a filter that *can* be easily cut in the block along with the objects adherent to its surface and within its meshes, a procedure quite impossible with filter paper. While filtration is the basis of this new method, and the use of ordinary filter paper is an essentially important part of it, it has been found necessary to find a substance that would serve as a filtering membrane that was porous, but not fibrous, because the presence of fibres is fatal to any attempt at cutting good sections in paraffine. On such a filtering membrane the organisms are caught and held where they are killed or fixed with any reagent, stained, dehydrated, and embedded, filter and all, in paraffine by means of the watch-glass method.

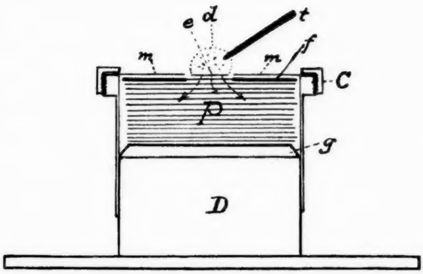
The filter upon which the objects are caught and killed consists of thin slices of elder pith. Get good, clean, whole pieces of elder pith, and clamp a piece of it into the holder of a Schanze or other sledge microtome, so as to make transverse sections of it, taking about four to six divisions of the micrometer wheel to each section. The microtome knife should be set at an acute angle with the line of movement of the knife carriage, as in cutting celloidin. With fresh pith, somewhat thinner sections may be cut. Upon examining such discoidal slices of elder pith, they will be found to be perforated at pretty regular intervals by openings caused by cutting through the very thin cellulose walls of certain of the pith cells. The pith filter is, it is thus seen, mechanically produced by the help of the microtome. A good

[1]Edited by C. O. Whitman, University of Chicago.

supply of these little pith filters can be cut and kept in stock in a pill-box, ready for use at any time.

The next step is to take some ordinary good white filtering paper, cut into disks or squares about one inch in diameter. With a small drop of water on the end of a wooden toothpick, moisten a point at the centre of one of these paper disks or squares, so as to make a damp area just about the area of one of the disks of pith. Then take a wire 1-16 inch thick, heat one end, and with its help place on the paper disk or square some melted paraffine. This may be heated with the hot wire so as to saturate the whole of the paper disk or square, *except the central moistened spot*, which must be left unsaturated with paraffine.

The next step is to prepare a discoidal pad about one inch in diameter, composed of 10 to 20 superposed thicknesses of filter paper. Upon this the disk or square of filter paper, with all but the central spot saturated with paraffine, is superposed. I find that the ordinary extra large live-box or compressor, provided with a mica cover, with a round perforation of ⅝ inch in diameter in its centre, is an excellent device for holding the disk prepared with paraffine down upon the thick pad of filter paper. The accompanying figure, showing the complete ap-



paratus in vertical section, will perhaps make the arrangement of its parts clearer. The cap-ring *C* of the large-sized live box or compressor holds the perforated mica cover *m m* in place. This perforation should be a little larger than the disk of pith *e*, immediately below which lies the disk of filter paper *f*, which is saturated with paraffine except at its centre. Then follows the pad of several thicknesses of filter paper *P*. The mode of operation is as follows: Place *P* upon the glass disk *g* of the live box or compressor; then lay *f* upon *P*; then put the cap *C* with its centrally perforated mica cover *m m* in place and slip it

down over the drum *D*, so as to firmly hold *f* down upon *P*; then moisten the central exposed part of *f*, that is not saturated with paraffine, with a little water with a fine-nozzled pipette; then pick up one of the little disks of elder pith by one edge with a fine forceps and lay it down on the moist centre of *f*, with the convex side down, when it will at once flatten out and adhere to *f* and just neatly cover the central area not saturated with paraffine. The apparatus is now in readiness to begin operations.

Place a drop of water (*d*) swarming with animalcules from a vigorous culture of infusoria on *e*, when it will be found that the water will be rapidly drawn through *e* and *f* into *P* in the direction of the arrows. In this way several drops of water may have a large part of their animalcular population separated out and caught upon the surface of *e*. To kill the contents of *D* it is only necessary to add a little saturated corrosive solution or osmic acid, one per cent., with the help of a thin, slender wooden rod or toothpick to the drop. Enough of either of these killing and fixing agents can thus be added as a minute drop by simply thrusting the charged end of the wooden rod or toothpick *t* into the drop *d*. The animalcules are at once precipitated by the killing agents upon the upper surface of *e*, where, strange to say, they are caught and held in the meshes formed by the pith cells. The filter *e* may now be gently removed and lifted off *f* by means of a needle and forceps. With gentle handling I find that Ciliates will remain attached to *e*, and may be passed through a dozen reagents without their becoming detached, and that the pith disk, with its adherent objects, may be embedded in paraffine very readily by the watch-glass method.

Care should be exercised that the edges of the opening in *m m* do not come too close to the edge of *e*, else the water of the drop *d* will run off edgewise between *m* and *f*, and thus not pass through *e* alone. The paraffined portion of *f* should project a little beyond the free edges of *m*. Under such conditions the drop charged with organisms will round itself off as in the figure, and be kept from spreading by the greasy circular inner margin formed by the paraffine that saturates the margin of *f*. In lifting off *e*, raise its free edge slightly at one point with a needle; then catch the edge thus raised between the blades of a sharp-pointed forceps and transfer to a watch-glass containing 50 to 60 per cent. alcohol; then through the other solutions in succession.

Even orientation may be very easily effected by means of this method, either by sketching the outline of the whole disk and the position and direction of the axes of the very minute objects on it under a low power of the microscope, or else by shaving down the block after

the disk of pith is embedded, so as to make it nearly transparent and so as to show the shape of the adherent organisms through the semi-transparent block under a low power of the microscope. The proper cutting planes may now be marked or indicated on the margin of the block with lithographic ink or with a fine camel's-hair pencil with lamp-black and turpentine. If the latter method is resorted to, great care must be exercised in scraping or shaving down the block to keep the plane along which the paraffine is removed parallel to the surface of the disk *e*.

I have found it very easy to thus capture, hold, kill, dehydrate, stain, embed and cut *Paramœcium aurelia*. *Euplotes*, *Stylonychia* and *Halteria* will also adhere to these disks. *Halteria* is about the size of a white blood-corpuscle, and the fact that it may be entrapped and treated as here described shows what a wide range of utility is promised by this new method of capturing and embedding minute organisms. It will doubtless also be found useful in the study of very minute eggs and larvæ.

I find that these pith disks, loaded with their adherent organisms, may be mounted entire, and one in this way may get most instructive preparations, often with half a dozen genera on a single slide. Staining is also entirely under control, and any of the usual stains or anilines or combinations of them may be successfully applied and the action watched under the microscope and arrested at just the proper moment. With this method it has been found possible to cut 18 longitudinal serial sections and 50 transverse serial sections of *Paramœcium* with a thickness of 2.5 to 5 μ with the Ryder Microtome set to 1 or 2 teeth of the micrometer wheel.

The fixation of the sections on the slide may be effected by means of Gustav Mann's albumen method. Take the white of an egg (30 c. c.), shake up with 300 c. c. of water for 5 minutes; filter twice. Paint clean slides on one side with this mixture with the aid of a glass rod, and stand up on end to drain and dry; 200 or more slides may be thus prepared and dried ready for use. The albumenized side of the dry sides may be distinguished by breathing upon them. The sections are to be stretched by floating the ribbon of paraffin containing them on warm water (30°c.). Immerse one end of the albumenized slide in the water and float and arrange the sections on it albumenized side uppermost. Place slide on water bath to dry, when the paraffin may be removed with xylol or turpentine after which the staining may be done on the slide. This method of fixing sections to slide with albumen is much simpler and more practical than with Meyer's formula.

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These pith disks may also be used to introduce into the serous cavities of higher organisms and left long enough to become filled with entrapped leucocytes or lymph cells. I anticipate that such a method would greatly facilitate the study of karyokinesis and its technique of staining in connection with wandering cells in wounds.

The novelty and simplicity of this new method, as well as its wide range of applicability, impels me to promptly offer it to my fellow-naturalists as a procedure that will in many cases be found to materially facilitate their work, especially the work of those engaged in the study of Protozoa, or of very minute ova or larvæ. A very simple form of this apparatus, for holding the filtering paper in position, is being made and offered for sale by Chas. Lentz & Sons, of Philadelphia.

Dec. 9th, 1894.

John A. Ryder.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

The American Society of Naturalists met in Baltimore at the Johns Hopkins University on Dec. 27th and 28th. The following were the officers: President, C. S. Minot; Vice-Presidents, William H. Dall, William Libbey, Jr., S. I. Smith; Secretary, W. A. Setchell; Treasurer, E. G. Gardiner; Committee at Large, H. F. Osborn, C. W. Stiles.

The Program was as follows: Thursday, December 27th, 2 P. M. Meeting in the Physical Laboratory for the following General Business: I. Reports of committees. II. Special reports. III. Recommendation of new members. IV. Discussion. Subject: Environment in its Influence upon the Successive Stages of Development and as a Cause of Variation. This was conducted by Prof. H. F. Osborn, Columbia College; Prof. E. B. Wilson, Columbia College; Prof. W. K. Brooks, Johns Hopkins University; Doctor C. Hart Merriam, U. S. Dept. of Agriculture. Thursday, 8 P. M., Illustrated lecture in Levering Hall, by Professor William Libbey, Jr., of Princeton University. Subject: Two Months in Greenland. Thursday, 9 P. M., The Johns Hopkins University received the members of the Society and their friends at a social assembly in McCoy Hall. Friday, December 28th, 9, A. M., General Session. I. Election of new members. II. Election of officers for 1895. III. Other business. Friday, 10 A. M., I. President's Address. Subject: The Work of Naturalist in the World, Prof. C. S. Minot, Harvard University. II. Annual Discussion. Subject: Laboratory Teaching of Large Classes. I. Introductory, Prof. Alpheus Hyatt, Boston Society of Natural History. 2. Zoological, Prof. H. C. Bumpus, Brown University. 3. Botanical, Prof. W. F. Ganong, Smith College. 4. General Discussion. Friday, 7.30 P. M., Annual Dinner of the Society of Naturalists and affiliated societies at The Stafford.

Officers for 1895 are President, Edward D. Cope, University of Pennsylvania; Vice-Presidents, Prof. William Libbey, Jr., Princeton; Prof. W. G. Farlow, Harvard; Dr. C. O. Whitman, University of Chicago; Secretary, Prof. H. C. Bumpus, Brown University; Treasurer, Dr. Edward G. Gardiner, Boston; Committee at large, Prof. Edmund B. Wilson, Columbia; Prof. W. H. Howell, Johns Hopkins.

The followed new members were elected: Dr. William Ashmead, United States Department of Agriculture; Dr. Severance Burrage,

Massachusetts Institute of Technology; Prof. H. E. Chapin, University of Ohio; Dr. J. E. Humphrey, Johns Hopkins University; Prof. Maynard Metcalf, Woman's College of Baltimore; Dr. W. H. C. Pynchon, Trinity College, and Dr. Norman Wyld, formerly assistant to Prof. Lloyd Morgan, in Bristol, England.

The American Morphological Society, met Dec. 27th and 28th at the Johns Hopkins University in Baltimore, Md. The following papers were read: Dr. C. W. Stiles, Larval Stages of an Anoplocephaline Cestode; Dr. W. A. Locy, Primitive Metamerism in Selachians, Amphibians and Birds; Dr. W. A. Locy, Note on the Homologies of the Pineal Sense Organ; Dr. E. B. Wilson, The Quadrille of the Centrosomes in the Echinoderm Egg; A second contribution to Biological Mythology; Dr. C. S. Minot, The Olfactory Lobe; Dr. C. S. Minot, The fundamental Difference between Animals and Plants; Dr. E. B. Wilson, The Polarity of the Egg in Toxopnenstes; Dr. A. Graf, The origin of pigment and the causes of the presence of patterns in Leeches; Dr. H. T. Fernald, Homoplasy as a Factor in Morphology; Mr. Seitaró Goto, The Anatomy of some Parts of Ectoparasitic Trematodes; Mr. A. P. Mathews, On the Morphological Changes in the Pancreatic Cell corresponding with Functional Activity; Mr. F. C. Kenyon, Anatomy and Relationships of Pauropida (read by Dr J. S. Kingsley): Dr. F. H. Herrick, Notes on the Biology of the Lobster; Prof. A. Hyatt, Remarks in the Bioplastology of Pecten; Dr. R. G. Harrison, Muscle Buds in the Pectoral fins of Teleosts; Dr. T. H. Morgan, The Minimum Size of Echinoderm Larvæ (read by Dr, E. A. Andrew).

The officers of the American Morphological Society for 1895 are: President, Dr. E. B. Wilson; Vice-President, Prof. W. B. Scott; Secretary and Treasurer, Dr. G. H. Parker; Members of Executive Committee from Society at large, Drs. T. H. Morgan and S. Watase.

American Physiological Society.—Seventh Annual Meeting, Baltimore, Md,, 1894 Thursday, December 27th, 9.30 A. M. The following general business was transacted. I. With regard to representation of this Society on a committee to decide the place of meeting of the Societies of Naturalists, Morphologists, Anatomists, and Physiologists, Pres.. H. P. Bowditch; II. Changes in the Tariff, E. T. Reichert, and J. W. Warren; III. The Teaching of Physiology in the Schools; W. H. Howell, and F. S. Lee; IV. A Physiological Journal, F. S. Lee, W. T. Porter, and H. H. Donaldson; III. A Subject for Discussion at the next Congress of American Physicians and Surgeons, The Council.

The following papers were read: G. M. Sternberg, "Explanation of Natural Immunity;" W. T. Porter, "Inhibition Hypothesis in the Physiology of Respiration;" S. J. Meltzer, "On Cardio-oesophagograms;" Mrs. C. L. Franklin, (Introduced by H. P. Bowditch), The Normal Defect of Vision in the Fovea;" T. E. Shields, (Introduced by W. H. Howell), "Demonstration of an Apparatus for the Plethysmographic Study of Odors, with Reports of Results;" W. T. Porter, "Hemisections of the Spinal Cord above the Phrenic Nuclei do not inhibit Thoracic Respiration;" G. T. Kemp, "Demonstration of a New Gas Pump for the Extraction of Blood-Gases;" Prof. H. A. Rowland, At the Physical Laboratory, "Exhibition of some New Forms of Galvanometers suitable for Physiological Use, with Remarks upon the Same."

Friday, December 28th, 9.30 A. M. J. G. Curtis, "Galen's Technical Treatise upon Practical Anatomy and Experimental Physiology;" G. Carl Huber, (Introduced by W. P. Lombard), "A Study of the Operative Treatment for Loss of Nerve Substance in Peripheral Nerves;" Franz Pfaff, (Introduced by H. P. Bowditch), "The active principle of Rhus toxicodendron and Rhus venenata;" F. S. Lee, "Further Experiments Upon Equilibrium in Fishes;" F. S. Lee, "Equilibrium in the Ctenophora;" G. P. Clark, (Introduced by F. S. Lee), "Equilibrium in the Crustacea;" W. T. Porter, "Acuteness of Vision in St. Louis Public School Children;" W. T. Porter, "The Weight of Dark-haired and Fair-haired Girls;" C. F. H. Hodge, (For Mr. C. C. Stewart), "A Means of Recording Daily Activity of Animals and the Influence upon it of Food and Alcohol;" C. F. Hodge, "The Influence of low Percentage of Alcohol Upon the Growth of Yeast." Visit to the New Anatomical and Histological Laboratories, the Hospital, etc. Election of New Members and other Business, at the New Anatomical Building. Reading of Papers and Demonstrations. J. J. Abel, "On the Occurrence of Diaethyl Sulphide in the Urine of the Dog, with a Demonstration of Reaction for the Detection of Alkylsulphides of the Series, $(C_N H_{2N} + _1)_2S$." J. J. Abel and T. B. Aldrich, "On the use of Trichloride of Acetonic Acid as an Anæsthetic for the Laboratory, with Some Account of its Fate;" J. J. Abel and A. C. Crawford, "Demonstration of Instances of Experimental Cachexia Thyreopriva in Dogs;" T. W. Mills, "Cortex of the Brain; (a) Localization; (b) Development of."

Council elected for 1894–95. H. T. Bowditch, President; R. H. Chittenden, W. H. Howell, W. T. Lombard; F. S. Lee, Secretary and Treasurer.

The Association of American Anatomists met in New York Dec. 28th and 29th, at the college of Physicians and Surgeons, under the following officers: Dr. Thomas Dwight, of Boston, Mass., President; Dr. B. G. Wilder, of Ithaca, N. Y., 1st Vice-President; Dr. F. J. Shepherd, of Montreal, Canada, 2d Vice-President; Dr. D. S. Lamb, of Washington, D. C., Secretary and Treasurer.

The following Papers and Discussions came before the Society. Friday, December 28th.—"The best arrangement of topics in a two years' course of Anatomy," by Dr. F. H. Gerrish, Bowdoin College. "History of the development of dentine," by Dr. Carl Heitzmann, New York City. "On the value of the nasal and orbital indices in anthropology," by Dr. Harrison Allen, University of Pennsylvania. "Loose characterization of vertebrate groups in standard works", by Dr. Burt G. Wilder, Cornell University. "The comparative anatomy of the cerebral circulation, with an exhibition of a series of anomalies of the circle of Willis" by Dr. Joseph Leidy, Jr., University of Pennsylvania. "Convolutions of the hemispheres of Elephas indicus;" by Dr. Geo. S. Huntington, College of Physicians and Surgeons, New York City. "Some muscular variations of the shoulder girdle and upper extremity, with especial reference to reversions in this region," by Dr. Huntington. Saturday, December 29th.—"On the significance of anomalies." Discussion opened by Dr. Thomas Dwight, Harvard Medical School. Followed by Dr. Frank Baker, University of Georgetown, D. C.; Dr. F. J. Shepherd, McGill University, Montreal; Dr. Burt G. Wilder, "Some anomalies of the brain"; Dr. Geo. S. Huntington; "Muscle variations in the Negro."

Officers for the years 1893–'94: Dr. Thomas Dwight, of Boston, Mass., President; Dr. B. G. Wilder, of Ithaca, N. Y., 1st Vice-President; Dr. F. J. Shepherd, of Montreal, Canada, 2d Vice-President; Dr. D. S. Lamb, of Washington, D. C., Secretary and Treasurer. Delegate to American Congress of Physicians and Surgeons: Prof. C. L. Herrick, of Granville, Ohio; Alternate: Dr. D. K. Shute, of Washington, D. C. Executive Committee: Dr. F. H. Gerrish, of Portland, Me.; Dr. Theodore N. Gill, of Washington, D. C.; Dr. Geo. L. Huntington, of N. Y. City and the President and Secretary, *ex officio*. Committee on Anatomical Nomenclature: Dr. Harrison Allen, of Philadelphia; Dr. Frank Baker, of Washington; Dr. Thomas Dwight, of Boston; Dr. Gerrish, of Portland; Dr. Burt G. Wilder, of Ithaca, Secretary.

Ohio Academy of Science.—This body met at Columbus, Dec. 27–8, 1894. The Officers were: President, F. M. Welester; Secretary; W. G. Tight. The following Papers were presented. 1. Preliminary List of Birds of Champaign County, J. A. Nelson. 2. Catalogue of the Odonata of Ohio, Part I, D. S. Kellicott. 3. Interesting and Little Mollusca of Ohio, V. Sterki. 4. Some New Points in the Structure of Dinichthys and Titanichthys, Albert A. Wright. 5. Additions to List of Coleoptera of Columbiana County, N. M. Hill. 6. Notes on the Bald Eagle, E. L. Mosely. 7. The Oaks of Ross County, Jane F. Winn. 8. An Improved Method of Determining the Laws of Acceleration in a Moving Body, Chas. E. Albright. 9. The Shaw Mastodon, Seth Hayes. 10. Preliminary Notes on the Distribution of Pronuba yuccasella, E. E. Bogue. 11. Glacial Till at Oberlin, Ohio, Lynds Jones. 12. On the Hitherto Unrecognized Horizon of Coal in Northeastern Ohio, E. W. Claypole. 13. A New Head of a Large Placoderm, Wm. Clark. 14. Grasses of Ashtabula County, Part I, Sara F. Goodrich. 15. Occurrence of the Gray King Bird in Ohio, Ernest W. Vickers. 16. Notes on the Variation of Liriodendron Leaves, Mrs. W. A. Kellerman. 17. Additions to the Bibliography of Ohio Botany, W. A. Kellerman. 18. On the Salina Group in Northeastern Ohio, E. W. Claypole. 19. Contributions to the Histology of the Order Nymphæaceæ as Represented in Ohio, E. M. Wilson. 20. Distribution of the Cranial Nerves of Cryptobranchus, J. H. McGregor. 21. A New Form of Ciliate Infusoria, V. Sterki. 22. Attractions for a Scientist in the Vicinity of Sandusky, E. L. Mosely. 23. An Other Miami Valley Skeleton, Including a Description of two rare Harpoons Found in Hamilton County, Sept. 22, 1894, Seth Hayes. 24. Notes on the Incubation of Turtle's Eggs, E. E. Bogue. 25. Five Birds New to Lorain County, Lynds Jones. 26. Unusual Nesting Site of the Pewee, E. W. Vickers. 27. A State Herbarium, W. A. Kellerman. 28. Some Notes on Collodion Imbedding, E. M. Wilcox. 29. Physalis viscosa, a Food Plant for Gelechia nigrimaculella, W. B. Hall. 30. Hygenic Dangers of Modern Civilization, E. L. Mosely. 31. Oligo-Nunk, Seth Hayes. 32. Insects New and Interesting at Oberlin, Ohio, Lynds Jones. 33. Summering of the Lark Sparrows in Mahoning Co. E. W. Vickers. 34. New Localities and New Plants for the Ohio Flora, W. A. Kellerman. 35. Notes on Sorex platyrhinus, E. W. Vickers. 36. Report on the Flora of Hocking Co., W. A. and K. F. Kellerman. 37. First List of Plants of Cedar Swamp, W. A. Kellerman and E. M. Wilcox. 38. The Development of the Watersheds of Ohio, W. G. Tight. 39. Entomological Notes for 1894 in Summit

County, E. W. Claypole. 40. Cetraria islandica. A Survivor of Glacial Times in Ohio, Edo Claassen. 41. The Phaenerogamic Exogenous Flora of Cuyahoga Co., Carl Krebs. 42. On a New Placoderm from the Ohio Shales, E. W. Claypole. 43. List of Birds Observed in Wayne County, H. C. Oberholser. 44. The Poisonous Plants of Ohio, Aug. D. Selby. 45. Two Cases of Buried Channels in the Licking River Valley, W. G. Tight. 46. The Pre-Glacial Channels of Paint Creek and North Fork, Gerard Fork. 47. Notes on Some New Introduced Plants, Aug. D. Seley. 48. List of Monocotyledonous Plants of Cuyahoga County, Edo Claassen. 49. Further Contribution upon Ohio Erysipheæ, Aug. D. Selby. 50. List of Cryptogamous Plants of Cuyahoga County, Edo Claassen. 51. The Department of Ceramics and Clay Working, and its Scope, E. Orton, Jr. 52. List of Monocotyledonous and cryptogamous Plants, being additions to the Lists 1 and 2 of the Nine Counties of Ohio, Edo Claassen. 53. Vitality of Vegetable Seeds, William R. Lazenby.

The officers of the meeting were: F. M. Webster, President, Wooster, Ohio. W. G. Tight, Secretary, Granville, Ohio.

The Indiana Academy of Science met at Indianapolis, December 27 and 28, 1894. The following were the Officers and Ex-Officio Executive Committee: W. A. Noyes, President; A. W. Butler, Vice-President; C. A. Waldo, Secretary; W. W. Norman, Assistant Secretary; W. P. Shannon, Treasurer; D. S. Jordan, T. C. Mendenhall, J. M. Coulter, O. P. Hay, J. P. John, J. L. Campbell, J. C. Branner, J. C. Arthur, Ex-Presidents.

The following Papers were read. Address by the Retiring President, Professor W. A. Noyes. 1. Some facts in the distribution of Gleditschia triacanthos and other trees Ernest Walker. 2. Propagation and protection of game and fish, I. W. Sharp. 3. Anthropology; the study of man, Amos. W. Bulter. 4. A new biological station and its aim, C. H. Eigenmann. 5. Transmission of impressions in spinal cord, G. A. Talbert. 6. Does high tension of electric current destroy life? J. L. Campbell. 7. The Purdue enigneering laboratory since the restoration, Wm. F. M. Goss. 8. Method of determining sewage pollution of rivers, Chas. C. Brown. 9. Psychological laboratory of Indiana Univ., W. L. Bryan. 10. Interesting deposit of alumina oxyhydrate, G. W. Benton. 11. Observations on glacial drift of Jasper Co., A. H. Purdue. 12. Concerning a burial mound recently opened in Randolph county, Joseph Moore. 13. Reversal of current in the Toepler Holtz electrical machine, J. L. Campbell. 14. A Florida shell mound U.

F. Click. 15. Note on rock flexure, Edward M. Kindle. 16. The alternate-current transformer with condenser in one or both circuits, Thomas Gray. 17. Elastic fatigue of wires, C. Leo Mees. 18. A warped surface of universal elliptic eccentricity, C. A. Waldo. 19. Accurate measurements of surface tension, A. L. Foley. 20. Effect of the gaseous medium on the electrochemical equivalent of metals, C. L. Mees. 21. Some new laboratory applicances in chemistry, H. A Huston. 22. Volumetric determination of phosphorus in steel, W. A. Noyes and J. S. Royse. 23. Action of ammonia upon dextrose, W. E. Stone. 24. Action of zinc ethyl on ferric chloride and ferric bromide, H. H. Ballard. 25. The sugar of the century plant, W. E. Stone and Dumont Lotz. 26. Camphoric acid, W. A. Noyes. 27. Action of potassium sulfhydrate upon certain aromatic chlorides, Walter Jones and F. C. Scheuch. 28. A new phosphate, H. A. Houston. 29. Dip of the Keokuk rocks at Bloomington, Ind., Edward M. Kindle. 30. Structural geologic work of J. H. Means in Arkansas, J. C. Branner. 31. Wave marks on Cincinnati limestone, W. P. Shannon. 32. Correlation of Silurian sections in eastern Indiana, V. F. Marsters and E. M. Kindle. 33. Some new Indiana fossils, C. E. Newlin. 34. Extinct fauna of Lake county, T. H. Ball. 35. Strepomatidæ of the Falls of the Ohio, with their synonymy, R. Ellsworth Call. 36. Streams of southeastern Indiana, with list, H. M. Stoops. 37. The swamps of Franklin county, H. M. Stoops. 38. Water cultures of indigenous plants, D. T. MacDougal. 39. Working shelves for botanical laboratory, Katherine E. Golden. 40. New apparatus for vegetable physiology, J. C. Arthur. 41. Collections of plants made during the year, M. B. Thomas. 42. The flowering plants of Wabash county, A. B. Ulrey and J. N. Jenkins. 43. Revision of the phanerogamic flora of the state, Stanley Coulter. 44. Report of progress of the botanical division of the State Biological Survey, L. M. Underwood. 45. Value of seed characters in determining specific rank in the genus Plantago, Alida M. Cunningham. 46. Additions to the fish fauna of Wabash county, W. O. Wallace. 47. Notes on the reptilian fauna of Vigo, W. S. Blatchley. 48. Preliminary list of birds of Brown co., Edward M. Kindle. 49. The birds of 1893, Amos W. Butler. 50. Some notes on the blind animals of Mammoth Cave, with exhibition of specimens, R. Ellsworth Call. 51. The batrachians and reptiles of Wabash co., W. O. Wallace. 52. On the occurrence of the whistling swan (*Olor columbianus*) in Wabash county, A. B. Ulrey. 53. Birds of Wabash county, A. B. Ulrey and O. W. Wallace. 54. Birds observed in the Sawtooth mountains, B. W. Evermann and J. T. Scovell. 55. Ani-

mal parasites collected in the state during the year 1894, A. W. Bitting. 56. Angling in the St. Lawrence and Lake Ontario, Barton W. Evermann. 57. Indiana mammals, Amos W. Butler. 58. Mimicry in fishes, W. J. Moenkhaus. 59. Variation in Leuciscus, C. H. Eigenmann. 60. The redfish of the Idaho lakes, B. W. Evermann and J. T. Scovell. 61. Observations upon some Oklahloma plants, E. W. Olive. 62. Rediscovery of Hoy's white fish or moon-eye (*Argyrosoma hoyi*), Barton W. Evermann. 63. Saxifragacesea of Indiana, Stanley Coulter. 64. The range of the blue ash, W. P. Shannon. 65. Plant products of the U. S. Pharmacopœa (1890), John S. Wright. 66. Noteworthy Indiana phanerogams, Stanley Coulter. 67. Methods of infiltrating and straining *in toto* the heads of Vernonia, E. H. Heacock. 68. Embryology of the Ranunculaceæ, D. M. Mottier. 69. Certain chemical features in the seeds of Plantago virginiana and P. patagonica, Alida M. Cunningham. 70. Root system of Pogonia, M. B. Thomas. 71. Salt-rising bread, Katherine E. Golden. 72. An increasing pear disease in Indiana, L. M. Underwood. 73. Notes on the Florideæ, Geo. W. Martin. 74. Measurement of strains induced in plant curvatures, D. T. MacDougal. 75. The stomates of Cycas, Edgar W. Olive. 76. The buckeye canoe of 1840, W. P. Shannon. 77. Embryo-sac of Jeffersonia diphylla, Frank M. Andrews. 78. Cell structure of Cyanophyceæ, Geo. W. Martin. 79. Some notes on the amoeba, A. J. Bigney. 80. Variations of Polyporus lucidus, L. M. Underwood. 81. Preliminary account of the development of Etheostoma cœruleum, A. B. Ulrey. 82. Embryology of the Cupuliferæ, D. W. Mottier. 83. Embryology of the frog, A. J. Bigney. 84. Variation in Etheostoma, W. J. Moenkhaus. 85. Blood corpuscles of very young human embryo, D. W. Dennis. 86. Poisonous influences of some species of Cypripedium, D. T. MacDougal. 87. Development of sexual organs of Cymatogaster, C. H. Eigenmann. 88. The vegetation house as an aid in research, J. C. Arthur. 89. The proposed new systematic botany of North America, L. M. Underwood.

The officers elected for the ensuing year are: President, A. W. Butler, Brookville, Ind.; Vice-President, Stanley Coulter, La Fayette, Ind.; Secretary, John S. Wright, care of Eli Lilly and Co., Indianapolis, Ind.; Assistant Secretary, A. J. Bigney, Moore's Hill, Ind.; Treasurer, W. P. Shannon, Greensburg, Ind.

Iowa Academy of Science, met at Des Moines, Iowa, Decembe 27 and 28, 1894.—The officers of the Academy are: President, L. W. Andrews; First Vice-President, H. W. Norris; Second Vice-President,

C. R. Keyes; Secretary and Treasurer, Herbert Osborn; Ex-officio, L. W. Andrews, H. W. Norris, C. R. Keyes, Herbert Osborn; Elective, C. C. Nutting, M. F. Arey, W. S. Hendrixson; Librarian, C. R. Keyes.

The following papers were read: 9 A. M., Business Session of Council. 10 A. M., J. E. Todd and Foster Bain: 1. Inter-Lœsial Till near Sioux City; H. Foster Bain: 2. Pre-Glacial Elevation of Iowa; 3. The Central Iowa Section of the Mississippian Series; Charles R. Keyes: 4. Secular Decay of Granitic Rocks; 5. Structure of Paleozoic Echinoids; 6. Opinions Concerning the Age of the Sioux Quartzite; 7. Illustrations of Glacial Planing in Iowa; Arthur J. Jones: 8. Record of the Grinnell Deep Boring; 9. The Topaz Crystals of Thomas Mountain, Utah; A. G. Leonard: 10. The Lansing Lead Mines; F. M. Fultz: 11. How Old is the Mississippi? 12. On the Formation of the Flint Beds of the Burlington Limestones; 13. Coincidence of Present and Pre-glacial Drainage Systems in Extreme South-eastern Iowa; 14. Extensions of the Illinois Lobe of the Great Ice Sheet into Iowa; 15. Glacial Markings in South-eastern Iowa; S. Calvin: 16. The Maquoketa Shales in Delaware County, Iowa; 17. On Some Supposed Devonian Outliers in Delaware County, Iowa; William H. Norton: 18. On the Occurrence of *Megalomus canadense* in the LeClaire Beds at Port Bryon, Ill.; 19. Geological Section of Y. M. C. A. Artesian Well at Cedar Rapids, Iowa. 1 P. M. Report of Secretary and Treasurer. Report of Librarian. Report of Committees. 2 P. M. L. W. Andrews: 20. President's Address, Recent advances in the Theory of Solutions; C. C. Nutting: 21. Report of Committee on State Fauna; W. S. Franklin: 22. A New Method of Studying the Magnetic Properties of Iron; 23. On the Design of Transformers and Alternating Current Motors; 24. Note on a Phenomenon of Diffraction in Sound; W. S. Windle: 25. A. Kymograph and Its Use; A. C. Page: 26. The Volatility of Mercuric Chloride; N. E. Hansen: 27. Notes on Applying Pollen in the Crossbreeding of Plants. 9 A. M. Business Meeting. 9.30 A. M. C. F. Curtiss: 28. Changes that Occur in the Ripening of Indian Corn; G. E. Patrick: 29. Methods of Soil Analysis; Floyd Davis: 30. The Coal Supplies of Polk County, Iowa; D. B. Bisbee: 31. A Study of the Nitrogen Compounds of the Soil; W. H. Heileman: 32. A Chemical Study of Honey; A. A. Bennett: 33. Notes from the Chemical Laboratory, Iowa Agricultural College, 1894. 1.30 P. M. F. C. Stewart: 34. Effects of Heat on the Germination of Corn and Corn Smut; C. W. Mally: 35. A General Discussion of the Family Psyllidæ, with

Descriptions of New Species found at Ames, Iowa; Alice M. Beach: 36. New Species of Thripidæ; Herbert Osborn and F. Atwood Sirrine: 37. Studies of Migration of Certain Aphididese; F. Atwood Sirrine: 38. Description of a Species of Aphid Occurring on Carex; L. H. Pammel and Alice M. Beach: 39. The Pollination of Cucurbits—by Title; Alice M. Beach: 40. Notes on the Pollination of Some Flowers; L. H. Pammel: 41. On the Migration of Some Weeds; 42. Notes on Fungus Diseases of Plants at Ames, Iowa, 1894—by Title; 43. Notes on the Flora of Western Iowa—by Title; L. H. Pammel and O. H. Pagelsen: 44. The Action of Antiseptics and Disinfectants on Some Micro-organisms; L. H. Pammel and Robert Combs: 45. Notes on a Micrococcus which Colors Milk Blue; Emma Sirrine: 46. On the Structure of the Testa of Polygonaceæ: Cassie M. Bigelow: 47. A Study of the Glands in Hoptree (*Ptelea trifoliata*). T. Proctor Hall: 48. Graphic Representation of the Properties of the Elements; 49. Strata Passed in Sinking a Well at Jidney; Arthur C. Spencer: 50. Notes on the Minerals of Webster County; A. H. Conrad: 51. Some Notes on the Reptiles of Southeastern Iowa; 52. Bones Found in a Cave in Louisa County; 53. Mastodon and Mammoth Remains in Southeastern Iowa; E. H. Lonsdale: 54. Cement Clays in Iowa; 55. Conclusions as to the thickness of the Upper Carboniferous in Southwestern Iowa; R. Ellsworth Call: 56. A Geograpical and Synonymic Catalogue of the Unionidæ of the Mississippi Valley—by title.

The officers elected for 1895 are: H. W. Norris, President; C. R. Keyes, First Vice-President; T. Proctor Hall, Second Vice-President; Herbert Osborn, Secretary and Treasurer; H. Foster Bain, Librarian; N. E. Hansen, T. H. McBride, and W. H. Norton, elective members of the executive council.

Des Moines Academy of Science.—Officers elected; Floyd Davis, recently of the New Mexico School of Mines, as President and J. Christian Bay, State Bacteriologist, as Secretary.

Boston Society of Natural History.—Dec. 5th, the following papers were read: Mr. Outram Bangs: Color variation in the geographical races of the white-footed mouse. Specimens were shown. Dr. C. B. Davenport: Bibliographic reform. Dr. G. H. Parker: Migration of pigment in compound eyes. December 19, Prof. W. M. Davis: Notes on certain European rivers. Stereopticon views were shown. January 2d, Dr. J. Walter Fewkes: The new fire ceremony at Walpi. Dr. Fewkes illustrated the aboriginal methods of fire-making.

SAMUEL HENSHAW, *Secretary.*

The Biological Society of Washington.—December 15. The following communications were made: Mr. Charles T. Simpson, On the Validity of the Genus *Margaritana.* Prof. C. V. Riley, Some Interesting Results of Injury to Tree. Dr. Erwin F. Smith, The Last Phase of the Root Tubercle Disease. Jan. 12, 1895.—The paper of the evening was: The Plant Individual in the Light of Evolution, By Prof. L. H. Bailey of Cornell University. FREDERIC A. LUCAS, *Secretary.*

SCIENTIFIC NEWS.

Sir Charles T. Newton, the eminent Archæologist, died Nov. 28.

The Medals of the Royal Society for 1894, were awarded as follows: Copley Medal to Dr. Edward Frankland; Rumford Medal to Professor Dewar; Royal Medals to Professor J. J. Thompson and Professor Victor Horsley; Davy Medal to Professor Peter S. Cleve; Darwin Medal to Right Hon. T. H. Huxley.

Dr. J. Walther has been appointed Professor of Geology and Paleontology at the University of Jena; and Dr. König Professor of Zoology at the University of Bonn.

A Government Museum for Natural History and Ethnology has been established at Para, Brazil, with Dr. Emil A. Goldi as first Director.

Mr. Robert T. Hill of the U. S. Geological Survey has gone to Panama.

Dr. H. C. Mercer of the Archeological Museum of the University of Pennsylvania, has gone to Yucatan.

Dr. Robert H. Lamborn died suddenly of rheumatism of the heart in New York, Jan. 14th. Dr. Lamborn was born at Kennett Square, Chester Co., Pa. in 1836. He graduated at the University of Giessen, and took the degrees of Ph. D. He wrote treatises on the metallurgy of silver, and of copper, and on Mexican Native Painters. He acquired a fortune in connection with various enterprises in the far West, especially by The Denver and Rio Grande R. R., the Mexican National R. R. etc. Of late years he was especially interested in Archeology, and he rendered invaluable assistance to various institutions in this direction. He also offered considerable prizes on two occasions, first for the best essay on the cultivation of dragon-flies for the destruction of musquitoes; and second, for the best essay on the characteristics of the best type of citizen. At the time of his death he was engaged on a research as to the part played in modern civilization by the Society of Friends, of which body he was born a member.

Mr. W. H. Ballou has sent to the Legislature of New York a draft of a bill creating a zoological park commission for the City of New York, and providing for the establishing of a zoological garden in Bronx or Pelham Bay Parks.

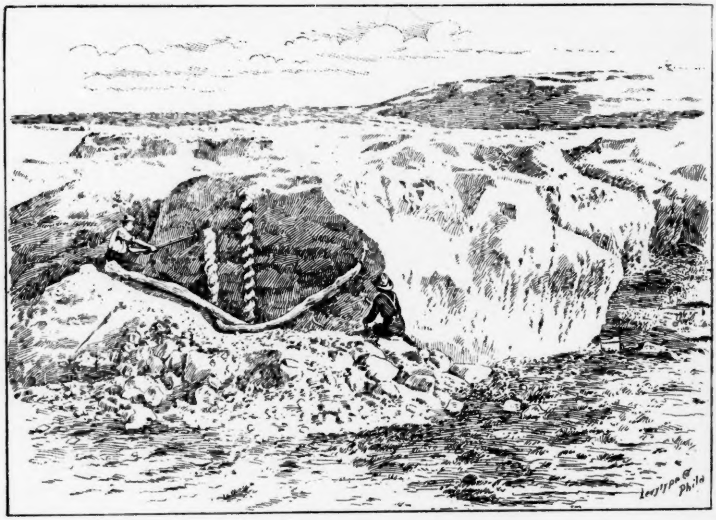
The Smithsonian Table at the Naples Station has been awarded to Professor T. H. Morgan for the dates Nov. 9, 1894 to May 8, 1895, incl., and to Prof. Herbert Osborn for the time May 9, 1895 to October. 8, 1895.

The table will be vacant from October 9, 1895 to June 8, 1896. Applications for it may be filed at any time with Professor Langley, Secretary of the Smithsonian Institution.

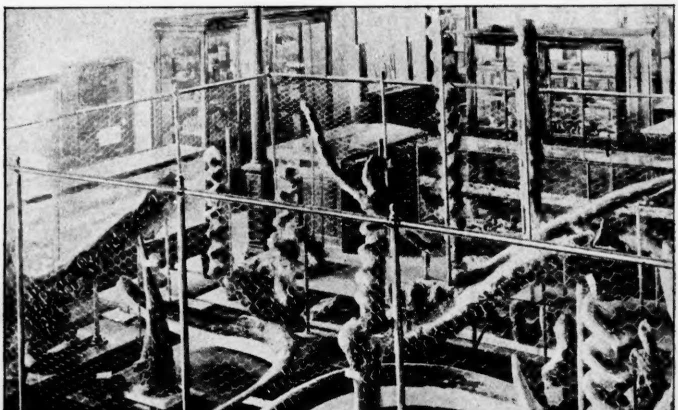
The next meeting of the Committee to consider applications will be on April 9, 1895.—W. C. STILES, Sec. Comm.

The weekly journal SCIENCE will be published after January 1st, under the direction of an editorial committee in which each of the sciences is represented by a man of science who is at the head of his department. The committee is constituted as follows: *Mathematics*, Prof. S. Newcomb (Johns Hopkins University and Washington); *Mechanics*, Prof. R. S. Woodward (Columbia College); *Physics*, Prof. T. C. Mendenhall (Worcester); *Astronomy*, Prof. E. C. Pickering (Harvard University); *Chemistry*, Prof. Ira Remsen (Johns Hopkins University); *Geology*, Prof. J. LeConte (University of California); *Physiography*, Prof. W. M. Davis (Harvard University); *Paleontology*, Prof. O. C. Marsh (Yale University); *Zoölogy*, Prof. W. K. Brooks (Johns Hopkins University), Dr. C. Hart Merriam (Washington); *Botany*, Prof. N. L. Britton (Columbia College); *Physiology*, Prof. H. P. Bowditch (Harvard University); *Hygiene*, Dr. J. S. Billings (Washington); *Anthropology*, Prof. D. G. Brinton (University of Pennsylvania), Major J. W. Powell (Washington); *Psychology*, Prof. Cattell (Columbia College).

PLATE XI.



Dæmonelix in place.



Dæmonelix in the Museum at Lincoln, Nebraska.